# AVR-2

## VIDEOTAPE RECORDER



MAINTENANCE

1809193

AMPEX

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# AVR-2
# VIDEOTAPE RECORDER

MAINTENANCE

AMPEX CORPORATION
AUDIO-VIDEO SYSTEMS DIVISION

# LIST OF EFFECTIVE PAGES

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# SECTION 1
# GENERAL INFORMATION

This manual describes the procedures required to maintain the AVR-2 Videotape Recorder. The manual is divided into three sections: General Information, Preventive Maintenance, and Corrective Maintenance. Preventive maintenance is described in procedural form and covers the routine maintenance required periodically to ensure optimum performance and to prolong the useful life of the recorder. Corrective maintenance describes the procedures required to troubleshoot the recorder, to replace parts, and adjust to establish normal operation.

It is assumed that technical personnel performing the maintenance operations understand the use of the vectorscopes, oscilloscopes and television monitors and are familiar with videotape recorders. It is recommended that maintenance personnel familiarize themselves with the information contained in the AVR-2 Theory of Operation manual, Catalog No. 1809179.

## TEST EQUIPMENT

In addition to the usual hand tools used by the technician, the test equipment and special tools listed in Table 1-1 are required in the maintenance of the AVR-2 system. The test equipment must be correctly calibrated and in proper working order. Table 1-2 describes the use of the test equipment and special tools included in the service tool kit.

**Table 1-1. List of Test Equipment and Special Tools**

| QTY. | ITEM | DESCRIPTION |
|---|---|---|
| 1 | Oscilloscope | Tektronix type 544 or equivalent. Bandwidth: DC to 50 MHz Time-base: 0.1 μs/cm to 5 s/cm |
| 1 | Oscilloscope Plug-In | Tektronix type 1A1 or equivalent. Dual trace, 5 mV/cm vertical sensitivity |

**Table 1-1. List of Test Equipment and Special Tools (Continued)**

| QTY. | ITEM | DESCRIPTION |
|---|---|---|
| 1 | AC Voltmeter | Hewlett Packard Model 3400A or equivalent. 1% accuracy at 50–1000 Hz |
| 1 | Audio Oscillator | Hewlett Packard Model 651B or equivalent. Generates 50-Hz to 20-kHz sine wave |
| 1 | Digital Voltmeter | Hewlett Packard Model 3462A or equivalent. 0.03% accuracy in 10 to 100 Vdc scale |
| 1 | Service tool kit | Ampex 1373244 |
| 1 | Alignment Tape | Ampex 52269-01 |

**Table 1-2. Service Tool Kit**

| TOOL | FUNCTION OR USE |
|---|---|
| Dial Indicator Assembly | Attaches to stud provided on video head; measures tip projection. |
| Microscope | Attaches to stud provided on video head; permits close examination of video head tips. |
| Pressure Measurement Attachment | Attaches to the capstan idler yoke to permit measurement of the capstan idler pressure. |
| Assembly Card Extender | Permits easy access to components and test points on the printed wiring assemblies by allowing the PWA to be extended out from the machine while remaining electrically connected to it. |
| Card Puller | Enables easy removal of the PWAs from their receptables in the electronics assembly. |
| Head Demagnetizer | Removes residual magnetism that builds up in the heads and tape guides. |

Table 1-2. Service Tool Kit (Continued)

| TOOL | FUNCTION OR USE |
|---|---|
| Spring Scale, 0–36 oz | Used to measure braking and holdback torques of reels. |
| Spring Scale, 0–72 oz | Used to measure takeup reel braking torque. |
| Spring Scale, 0–15 lb | Used to measure capstan idler pressure and reel braking forces. |

## SERVICE AND REPLACEMENT PARTS

Do not for any reason return material to Ampex without first obtaining a Material Return Authorization form or a Parts Exchange Order form (except in the case of video heads). Contact your nearest Ampex field office to obtain these forms, service, or replacement parts. If the installation of your system or accessory was supervised by an Ampex Field Engineer, you will be sent information regarding the location of the nearest field office. Alternatively, write to the Technical Support Group at Redwood City, California. In order to be sure that you always receive information applicable to your equipment, please include the following information when you write to us:

Model number

Catalog number

Serial number

Special accessories

Date of purchase

Name and address of your organization

Job function to which communication should be addressed

# SECTION 2
# PREVENTIVE MAINTENANCE

The recommended routine maintenance procedures and the intervals at which they should be performed are listed in the Maintenance Schedule, Table 2-1. In addition to the routine maintenance procedures, the exterior surfaces of the recorder should be cleaned with a clean lint-free cloth and a mild soap and water solution.

## DAILY MAINTENANCE PROCEDURES

The daily maintenance procedures should be performed at the start of each day or each shift of recorder use, and when a new video head assembly is installed.

### Head and Tape Path Cleaning

An effective cleaning agent recommended for a thorough cleaning of the heads (see Figure 2-1) and the complete removal of oxide and dust accumulation is Ampex Head Cleaner, part number 087-007. If this is unavailable, pure xylene may be used as a temporary substitute. In areas where flammable cleaning materials are not permitted, Freon TF**(Ampex part number 050-104) may be used. However, Freon TF is not as efficient as the other two cleaners. Isopropyl alcohol is recommended for cleaning the capstan idler.

A soft lint-free cloth is recommended to clean surface areas such as the tape guides, the tension arms and the tape timer; a cotton swab is recommended to clean smaller or less accessible surfaces, such as the video head tips and stationary heads. When using either, moisten (but do not saturate) the applicator with the cleaning agent. When cleaning any of the heads, exercise great care to avoid scratching the tape-contacting surfaces. Clean the head and tape path as follows:

**Table 2-1. Maintenance Schedule**

| | NEW HEAD INSTALLED | DAILY | 25 HR. | MONTHLY | PRIOR TO PLAYBACK OF A TAPE |
|---|---|---|---|---|---|
| Head and tape path cleaning* | X | X | | | |
| Control track current adjust* | X | | X | | |
| Head tip projection measurement* | X | | X | | |
| Video head optimization* | X | | X | | |
| Differential gain adjust* | X | | | | X |
| Equalize adjust* | X | | | | X |
| Vacuum guide height and tip penetration adjustment | X | | X | | |
| Air system filter check | | | | X | |

*Or adjust/clean as required.

**Freon TF is a registered trademark of E. I. Depont DeNemours Co.

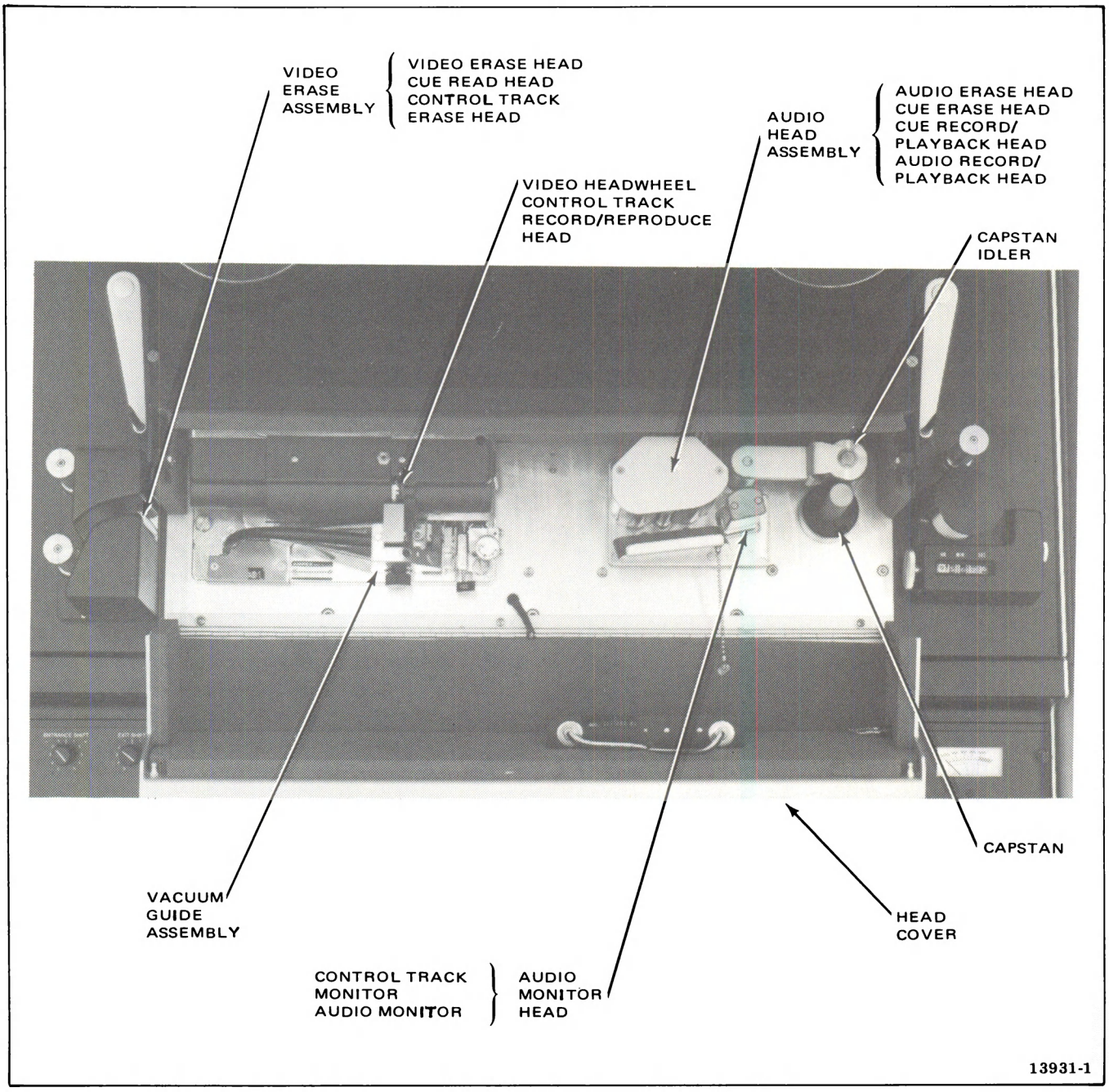



**Figure 2-1. Video, Audio, Cue, Control Track, and Erase Heads**

1. The system must be turned on (and in the stop mode) in order to supply air for the video head bearing. Push the MAIN POWER switch inward to supply power to the system. Ensure that the READY toggle switch is set to OFF.
2. Access the heads by opening the hinged head cover. Ensure that the video headwheel is not rotating.
3. Remove tape if it is threaded on the transport.

4. Swing the hinged vacuum guide away from its latched position close to the video headwheel by pulling latch release lever (see Figure 2-2) backward (towards operator) and pulling the vacuum guide assembly backward at the same time.

**CAUTION**

**THE SYSTEM MUST BE TURNED ON AND SUPPLYING AIR TO AIR BEARING IN THE VIDEO HEAD ASSEMBLY. ENSURE THAT THE BEARING AIR INDICATOR IS NOT LIGHTED. DO NOT MOVE THE HEADWHEEL IF BEARING AIR IS NOT SUPPLIED.**

5. Moving the headwheel by hand, use a cotton swab sparingly moistened with head cleaner (Ampex 087-007) to clean the headwheel. Use a careful, gentle scrubbing motion over each of the four head tips and around the circumference of the video headwheel. Also scrub the surfaces of the vacuum guide that contact the tape.

6. Clean the control track record/reproduce head. Use a lint-free strip of cloth about two inches long dampened with head cleaner. Insert cloth between control track head and shield; pull cloth back and forth across the control track head.

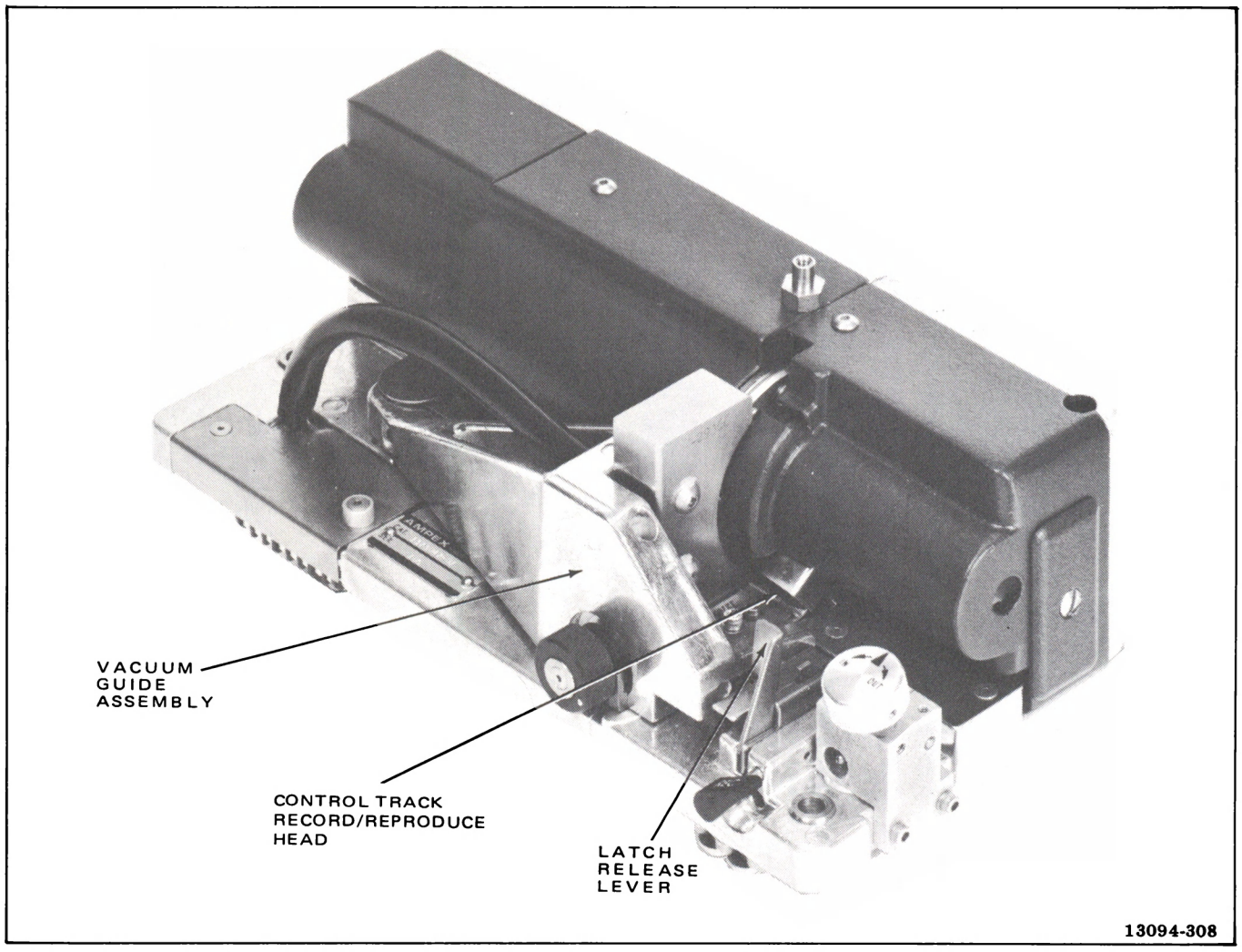



**Figure 2-2. Control Track Record/Reproduce Head**

7. Clean the video erase assembly; pull the erase assembly cover up and off to expose the heads.

8. Clean the audio and cue head.

9. Clean the audio and control track monitor heads if supplied with system.

CAUTION

**WHEN CLEANING CAPSTAN SURFACE, BE CAREFUL NOT TO GET HEAD CLEANER ON SURFACES OF CAPSTAN IDLER.**

10. Clean the tape-contacting surfaces of the capstan.

11. Clean the capstan idler with a lint-free cloth moistened with isopropyl alcohol. *Do not use head cleaner.* Turn the capstan idler by hand and clean the entire tape-contacting surface.

**Control Track Record Current Optimization**

Optimize the control track record current as follows:

1. Thread the tape to be used for recording on the machine.

2. Establish record mode by pressing and illuminating PLAY and RECORD pushbuttons simultaneously; allow the machine to run in the record mode for about 30 seconds to record a control track.

3. Press and illuminate REWIND pushbutton and rewind tape to the start of the recorded control track.

4. Press and illuminate CTL TRACK pushbutton.

5. Press and illuminate PLAY pushbutton to enter play mode.

6. Observe the control track on the waveform monitor. The C.T. REC LEVEL potentiometer has been adjusted for optimum control track record current when the monitored waveform indicates that magnetic saturation has just occurred. See Figure 2-3 for correct control track waveform.

   The control track playback waveform of Figure 2-3 labeled Low Level indicates that the control track has been recorded with insufficient record current and magnetic saturation has not occurred. The waveform labeled Correct Level indicates that the correct level of current has been used and magnetic saturation has just occurred.

   When the control track is recorded with greater current than is necessary to just cause magnetic saturation of the tape, an improper control track, labeled High Level, results. Note the distinct shoulders that are formed on the trailing end of the control track pulses when excessive current is used.

7. If monitored waveform indicates that greater record current is required (magnetic saturation has not occurred), adjust C.T. REC LEVEL potentiometer clockwise to increase current, rewind to the beginning of the tape, and repeat steps 2 through 6. If monitored waveform indicates less record current is required (magnetic saturation has not occurred), adjust C.T. REC LEVEL potentiometer counterclockwise to decrease current, rewind to the beginning of the tape, and repeat steps 2 through 6.

8. Repeat step 7 until saturation has just occurred and control track record current is thus optimized.

NOTE

**Control track record current may be optimized more rapidly by using the vu meter. Steps 9 and 10 provide for optimizing the control track record current by using the vu meter and are optional.**

9. Set AUD 1–AUD 2–CUE–C.T. MONITOR to C.T. MONITOR.

10. Play back the tape recorded with the optimized control track; note the level

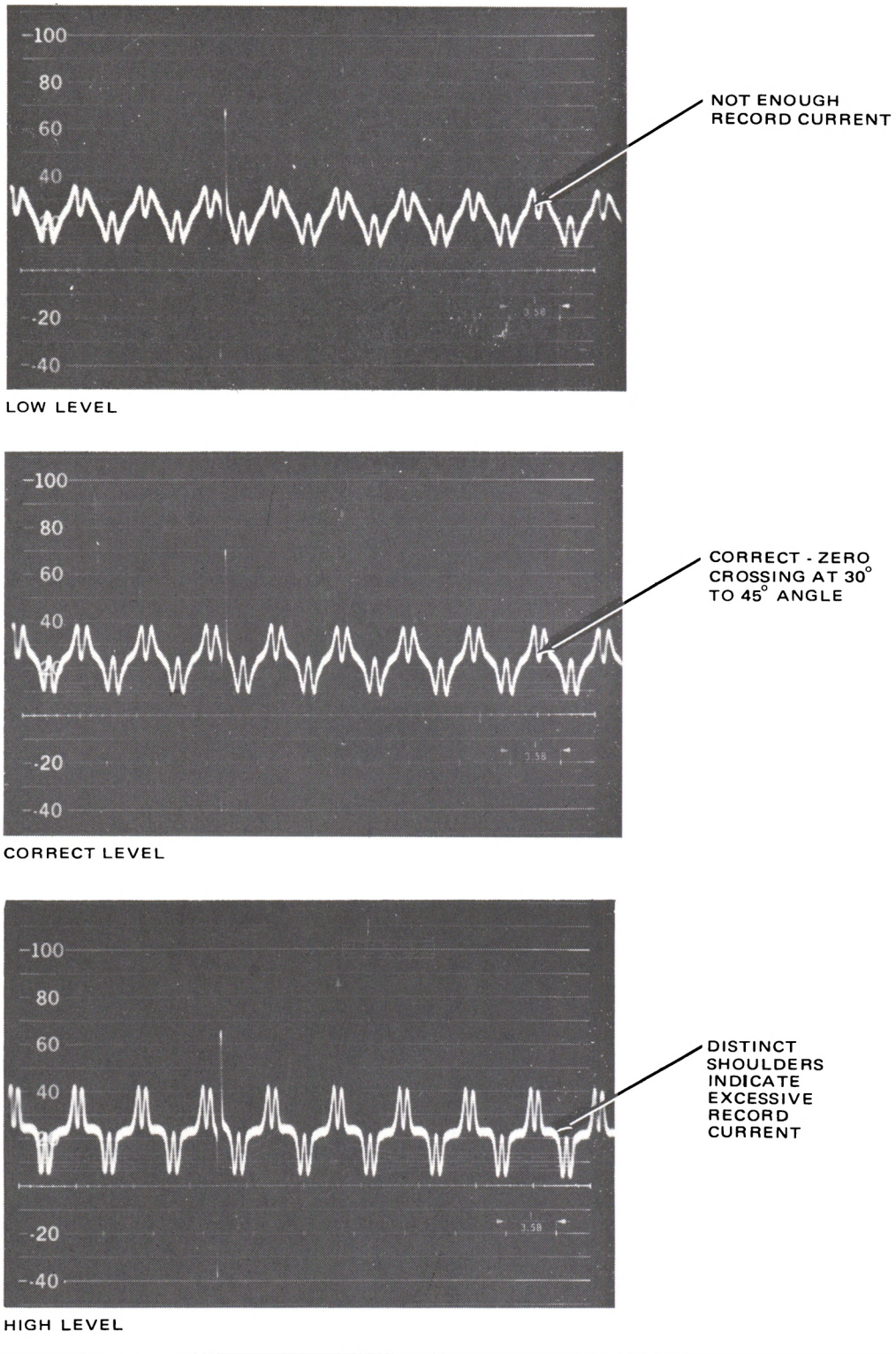



**Figure 2-3. Control Track Waveforms**

indicated on the vu meter. To optimize the control track in the future, observe the vu meter and adjust C.T. REC LEVEL for the level noted.

## 25-HOUR MAINTENANCE PROCEDURE

Twenty-five hours is the suggested maximum interval between the performance of the following procedures. Conditions may require their more frequent performance.

### Video Head Evaluation

Head life is limited by the wearing of the four head tips that results from the mutual tip-to-tape abrasion between the oxide coating on the tape and the material (Alfesil) of the tip. Abrasion is encountered by the tips in the record and playback modes as the video headwheel, rotating at more then 14,000 rpm, sweeps the tips across the tape. The head tips move at over 1500 inches per second while in close contact with the tape.

As the tip is abraded, the gap depth decreases; when there is no gap depth left, recording and playback is not possible. Initially on a new or refurbished video head, the gap depth is nominally 2000 microinches (2 mils). Tip wear rate is extremely sensitive to type and condition of the tape used. Tip wear rates ranging from 1 to 100 microinches per hour may typically be encountered. The Mark XV video head is guaranteed for 200 hours. Thus the average tip wear rate over the guaranteed life of the head is about 10 microinches per hour.

Damaged tape may cause rates of wear ranging up to 400 microinches per hour, thereby reducing useful head life to only a few hours. Tape that has been physically damaged by creasing, crumpling or scratching is the prime cause of high tip wear rates. Any sharp deformation or scratching of the oxide interrupts its continuity and uniformity, resulting in a cutting action somewhat akin to that of a file. Sharp deformations also result in loosened individual particles of oxide, which may be picked up and retained by the head tips or the head drum. When physically damaged tape passes the head tips, the tips are scratched by this cutting action. Then as more tape passes the scratched tips, it is in turn damaged by the milling action of the tips. For this reason, severely scratched head tips must be polished before further use.

When creased sections of tape pass the head tips, the rate of wear increases drastically, and loosened particles of oxide are picked up and retained by the head tips and the drum. Crumpled tape represents the greatest danger that the head tips may encounter. There is a virtual certainty of tip damage, in the form of long, deep scratches, and the subsequent damage of good tape by the damaged tips. Also, a rapid buildup of loose oxide may accumulate on the drum surfaces to aid in the destruction of the tape.

**Evaluation of Tip Abrasion by Tip Coloration.** Normal wear of polished head tips results in the appearance of tip coloration which is characteristic of the brand of tape in use. The density of the color and the area of the tip surface covered with color varies with the abrasive properties of the tape, and with the length of time the head has been in operation. In general, when a tape produces a color on the head tips, it is safe to use. It is to be expected that one brand of tape may wipe off the color produced by another brand, before producing its own characteristic coloration on the tips.

When the wear rate is less than 6 microinches per hour, the color produced is the most dense and covers the largest area on the tip surfaces. When the rate is between 6 and 15 microinches per hour, the color density will decrease or the colored area will become smaller. When the wear rate exceeds 15 microinches per hour, any color initially present on the head tips will disappear. Thus, if no coloration appears on the head tips, it may be assumed that the wear rate exceeds 15 microinches per hour.

**Evaluation of Video Head By Record/Playback Quality.** The following difficulties may indicate that the video head should be replaced.

- Insufficient range of equalization on a correctly recorded tape.
- Inability to achieve satisfactory playback from a recording after correct optimization.

Generally, one tip will usually degrade before the other three. A symptom which should alert the operator to this is that on playback of a correctly recorded tape, one equalizer setting will differ by several divisions from that of the other three.

### Tip Projection Measurement

Tip projection refers to the distance the tip projects above the surface of the drum or headwheel (see Figure 2-4). During normal use, as the head tip wears, the tip projection decreases. Periodic measurement of tip projection indicates the rate of tip wear. An excessive rate of tip wear is an indication that the tape being used is damaged or too abrasive.

The back of the gap of the head tip is above the drum surface by 0.0008±0.0001 inch. A tip projection measurement in this range indicates that there is little or no record/playback gap left. By the time the tip projection measurement is about 1 mil, the quality of the record/playback process has usually degraded sufficiently to warrant replacement of the video head. Tip projection should be measured at intervals of 25 hours of head use, as determined by reading the head hours meter housed beneath the top of the tape transport. The results of the tip projection measurement should be logged. Measure the tip projection as follows.

**CAUTION**

**THE FOLLOWING STEPS MUST BE PERFORMED WITH EXTREME CARE, ENSURING THAT NO PART OF THE DIAL INDICATOR STRIKES THE HEAD DRUM OR TRANSDUCERS FORCIBLY. BEARING AIR MUST BE SUPPLIED TO THE HEAD DURING THE MEASUREMENT TO PREVENT DAMAGE TO THE BEARING SURFACES WHEN ROTATING THE DRUM.**

1. Turn the system power on to supply air pressure to the video headwheel air bearing.

2. Set READY toggle switch to OFF; ensure that video headwheel is not rotating.

3. Mount the dial indicator assembly (Ampex Part No. 1209742) on the stud provided on the video head. Position the dial indicator so that its contact pin is not resting on the drum surface, but is located about 45° to the right of the drum. This is to avoid any damage to the drum or tips when initially mounting the dial indicator or when rotating the drum to locate the reference surface. Tighten mounting screw on the indicator mounting bracket until the indicator is just snug, but movable, about the mounting stud.

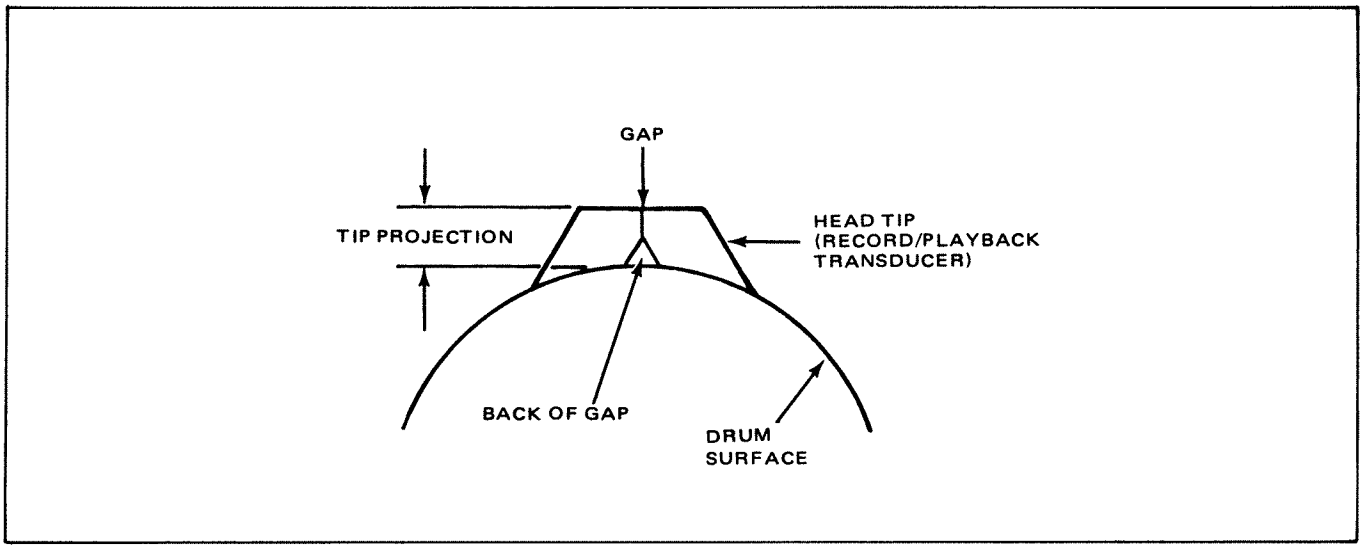



**Figure 2-4. Tip Projection**

4. Rotate the drum until the reference surface of the drum, just behind tip number one, is positioned at the top of the head assembly. In this position, the dial indicator can be rotated on its mounting stud to center its contact pin over the reference surface. Tip number 1 can be identified either by a paint spot near its mounting shoe or by similar identification marks on the plastic ring that connects the transducer leads to the rotary transformer.

5. Carefully rotate the dial indicator about its mounting stud until the contact pin is centered and resting on the reference drum surface. After this positioning, if necessary, loosen the dial lock screw and set the dial indicator to read zero by rotating the zero set ring (the outer ring on the indicator gauge); then lock the zero set ring in place with the dial lock screw. Now tighten the dial indicator snugly on the mounting stud.

CAUTION

ALLOW THE DIAL INDICATOR CONTACT PIN TO RIDE ON THE DRUM AND TIP SURFACES WHILE ROTATING THE DRUM WITH THE FINGER TO MEASURE TIP PROJECTION OF THE REMAINING TIPS. LIFTING THE CONTACT PIN FROM THE DRUM SURFACE UNTIL A TIP IS DIRECTLY UNDER THE INDICATOR INCREASES THE POSSIBILITY FOR THE CONTACT PIN OF THE DIAL INDICATOR TO BE DROPPED ON THE TIP CAUSING PERMANENT DAMAGE.

6. With the finger, slowly rotate the head drum in its normal, counterclockwise direction until a tip comes under the contact pin. Record the tip projection reading at the point of maximum dial deflection.

NOTE

**Due to slight variations in the head drum diameter, the dial may not return exactly to zero after measuring each tip. This is not significant in the measurement process if the reference surface behind tip number 1 is always used to zero the indicator gauge. It is recommended that the measurement process be repeated two or three times and an average reading used to determine tip projection.**

7. Repeat the procedure of step 6 for each of the remaining head tips and record the tip projection of each.

8. Remove the dial indicator assembly immediately after taking measurements, remembering that permanent damage to the head might result if the head drum is rotated rapidly while the dial indicator is mounted on the head assembly.

### Video Head Preventive Maintenance

Observance of the following precautions will prolong the life of the Mark XV video head.

- Before each day of use, closely inspect all metal surfaces that touch the oxide-coated surface of the tape (including tape guides, idlers, compliance arms, head tips and drum) for an accumulation of oxide. If any is present, remove it immediately, using a cotton swab moistened with head cleaner.

- Be alert for sections of tape that are crumpled, creased, or scratched. These sections appear most often near the beginning of the tape; but wherever they appear, they must be removed before the tape is used to avoid needless head-tip damage.

- Examine the head tips daily with the video head assembly mountable microscope provided in the service tool kit. The condition of the tapes being used may be determined by the appearance of the head tips. If severe scratches are detected, polish the tips by running the head for a short period with a tape that produces a polished condition. If any head tips are found to be broken, do not use the video head assembly until it has been repaired or exchanged.

- While tape is being manipulated by hand, use care to avoid situations that may lead to creasing or crumpling.

- Remember that degradation of the reproduced picture caused by a buildup of oxide on the head tips is usually accompanied by a buildup of oxide on the drum surfaces as well. Make it a practice to clean the head tips and the head drum as soon as possible after such degradation first appears.

### Video Head Assembly Removal and Replacement

If the condition of the head tips warrants, remove and replace the video head assembly as follows:

1. Turn off the power to the recorder.

2. Unscrew the three holddown screws and remove the two that are not captive to the head assembly.

3. Remove the head assembly by lifting it away from the tape transport.

Before installing the head assembly, determine that its characteristics are correct for the operation of the AVR-2. The proper head tip width should be 5 mils for 7.5 in/s and either 5 mils or 10 mils for 15 in/s. To install a video head assembly, proceed as follows:

1. On the head assembly, push in the REC/PLAY lever, turn it clockwise to the REC position, and release it.

2. Position the head assembly so as to align both of the connector plugs with their mating receptacles.

**CAUTION**

**USE CARE WHEN MOUNTING THE HEAD TO AVOID BENDING ANY OF THE CONNECTOR PINS. AVOID WARPING THE HEAD PLATE BY FIRST TIGHTENING ALL SCREWS LIGHTLY. THEN TIGHTEN THE TWO SCREWS AT THE RIGHT-HAND SIDE OF THE HEAD. TIGHTEN THE SCREW AT THE LEFT-HAND SIDE OF THE HEAD LAST.**

3. Secure the assembly to the top plate with the three holddown screws.

4. Turn on the air pressure to the recorder. Insert a fingertip in the opening adjacent to the tach wheel and spin the rotor. If the rotor does not spin freely, an adjustment of the clearance between the rotor and the stator of the rotary transformer may be required.

5. Clearance between the rotor and the stator of the rotary transformer is adjusted by means of the slotted-head screw accessible through the round hole in the right end of the transformer cover. While manually turning the rotor, turn the slotted-head screw slowly counterclockwise until a drag is just perceptible; then turn it clockwise until the drum rotates freely. Finally, turn the screw clockwise an additional 1/16 turn (22.5°). Reactivate power to the drum motor.

### Video Head Optimization

For optimum playback response with minimum distortion, the amount of record current or record drive used during the record mode is critical. The tip must be driven sufficiently to just saturate the magnetic domains on the tape. In playback, this will produce maximum output voltage from the head tips. The optimum current varies with the brand or type of tape and between tips. The optimum point also changes as the tip wears down and the gap becomes shallower. For these reasons the video head tips should be optimized at least every 25 hours of head operation (as read on the head hours meter) and prior to recording after having changed brands or types of tape.

The optimum record current may be conveniently established while the system is in the VHO mode. In the VHO mode, the tape forward speed is reduced to 3-3/4 IPS (1/4 normal) while normal video headwheel speed is maintained. At this tape speed, using a 10-mil head, no guard band exists between tracks; as one tip leaves contact at the

bottom of the tape, the following tip, 90° behind, enters the tape and retraces the track recorded by its predecessor. The head tips are optimized one at a time. The head tip chosen to be optimized is automatically placed in the record mode and the following tip is automatically placed in the playback mode. As the track is alternately recorded and played back, the result on the playback response of varying the record current may be immediately seen on the TRACKING meter. The procedure for optimizing the video head is as follows:

1. Supply the system with a composite video input signal.
2. Push MAIN POWER switch in the electronics assembly inward to apply power to the system.
3. Thread a reel of tape (unused or containing recorded material that is no longer needed) on the transport.
4. Press PLAY and RECORD pushbuttons on the control panel simultaneously with the INITIATE pushbutton on the maintenance panel.
5. Set the OPTIMIZE selector switch on the maintenance panel to 1.
6. Unlock the VIDEO RECORD-CHAN 1 control by turning the locking ring counterclockwise.
7. Turn VIDEO RECORD-CHAN 1 control fully counterclockwise.
8. Turn VIDEO RECORD-CHAN 1 control clockwise slowly until the rf level observed on the TRACKING meter on the control panel reaches maximum. As the control is turned, the gain will flatten out after a fast initial rise; stop turning the control as soon as a small clockwise movement does not increase meter reading. The optimum record current can also be determined by pressing RF LEVEL on the monitor control panel and observing the rf level on the waveform monitor. Adjust the VIDEO RECORD-CHAN 1 control for maximum rf level playback.
9. Lock the VIDEO-RECORD-CHAN 1 control in position by turning the locking ring clockwise.
10. Repeat steps 5 through 9 for channels 2 through 4; with OPTIMIZE selector switch set to 2, optimize head 2 record current by adjusting VIDEO RECORD-CHAN 2 control, etc.

**Filter Cleaning**

It is imperative that the filter in the air system be kept clean. If the filter is allowed to become clogged, air flow will be impeded and unsatisfactory performance or damage to the system will result; if the filter is damaged it will not filter efficiently and the results may cause system damage. Clean the filter as follows:

1. Ascertain that the system power is turned off and that the air pressure to the system is also turned off. Check that the air pressure gauge on the compressor assembly indicates zero.
2. Pull the control panel up and forward to gain access to the tape transport latch.
3. Release the tape transport by pulling the latch handle down and to the right (see Figure 2-5). When released from the latch, the tape transport pivots (front of the tape transport rises), permitting access to the assemblies on the underside of the tape transport.
4. Unscrew the glass filter bowl in the air supply and remove the bronze filter from the bowl. Remove the bronze filter from the supply line by unscrewing it from its fitting. These filters may be cleaned in an ultrasonic solvent cleaner, or soaked in solvent and blown dry with air at 25 psi. If neither of these methods can be used, replace the filters with new ones.
5. Clean the inside of the filter bowl and wipe dry with a lint-free cloth.
6. Re-install the filters and re-install glass bowl by screwing it to its fitting.
7. Unscrew the glass bowl from the vacuum supply.

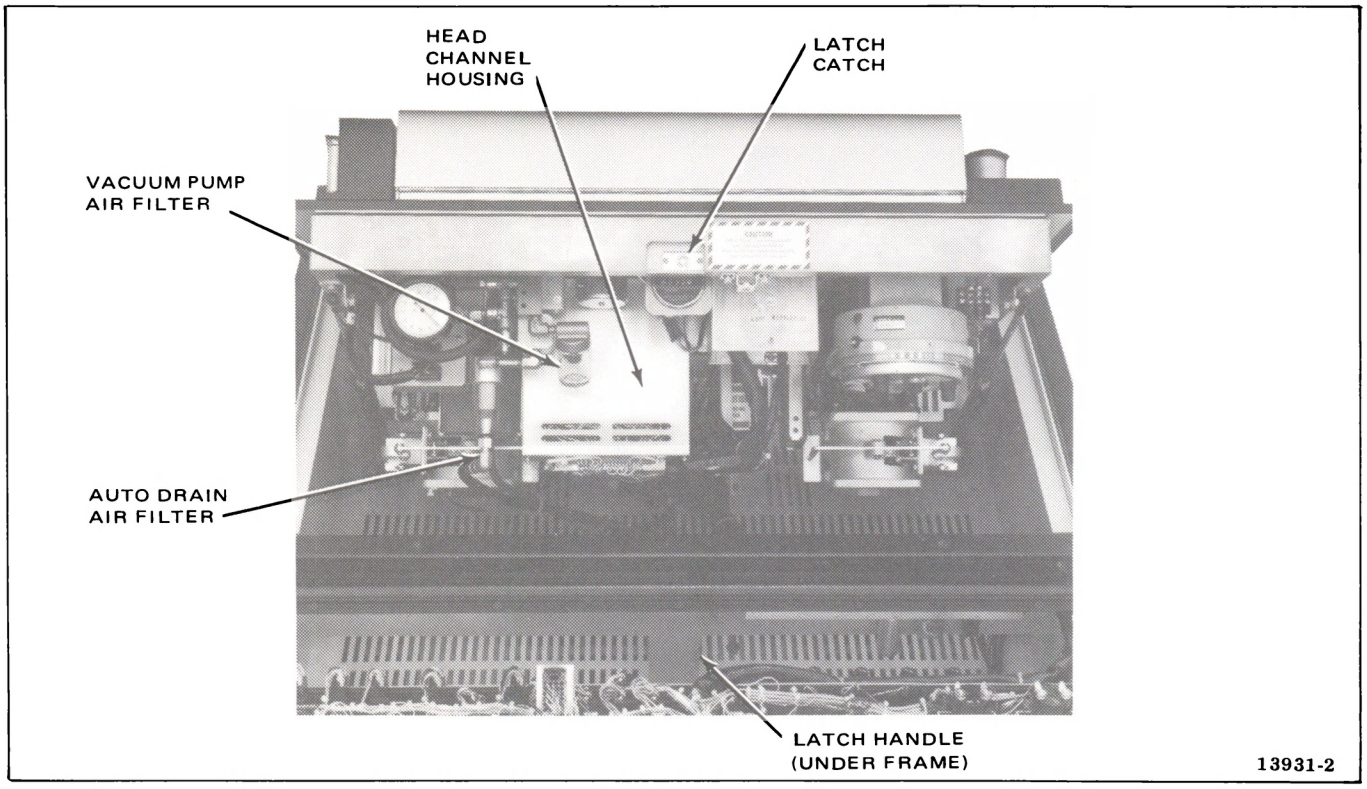



**Figure 2-5. AVR-2 Tape Transport Tilted for Access to Underside**

8. Clean and re-install the bowl.

9. Close and latch the tape transport.

10. Check and, if necessary, clean the filters on the air compressor that is supplying air to the recorder.

### Measurement of Signal-to-Noise Ratio

A method for measuring the signal-to-noise ratio of the video signal system is as follows:

1. Clean and demagnetize the tape path.

2. Optimize the record current to the video head.

3. Preferably using tape that has had ten passes, record and play back a stairstep, window, or pulse and bar signal. Make certain that sync tip frequency and peak white frequency are correct during recording and that the system is set up for unity gain (1.0 Vp-p in and 1.0 Vp-p out or 1.4 Vp-p in and 1.4 Vp-p out). Adjust the TRACKING control for maximum meter indication.

4. Measure peak noise on the stairstep, window or bar signal using a high gain scope preamp. The difference between input and output in playback is the peak noise in millivolts. Use Table 2-2 to convert to video signal-to-noise ratio in decibels.

### Differential Gain and Equalizer Adjustments

For systems equipped with an auto chroma accessory, either of the following two procedures can be used as preferred. The third procedure given is to be used for systems not equipped with auto chroma. Perform differential gain and equalizer adjustments as follows:

1. Connect an input signal to the AVR-2 consisting of a staircase with *exactly* 40 IEEE units sync and color burst.

Table 2-2. Signal-to-Noise Ratio Conversion Table

| NOISE ON PLAYBACK VIDEO IN mV (SCOPE RESPONSE FLAT TO 4.2 MHz) | S/N IN dB | |
|---|---|---|
| | FOR 1.0 Vp-p VIDEO OUTPUT $E_{pk\ video}$ = 643 mV | FOR 1.4Vp-p VIDEO OUTPUT $E_{pk\ video}$ = 900 mV |
| 10 mV | 52 dB | 55 dB |
| 15 mV | 48 dB | 51 dB |
| 20 mV | 45 dB | 49 dB |
| 25 mV | 43 dB | 46 dB |
| 30 mV | 41 dB | 44 dB |
| 35 mV | 40 dB | 43 dB |
| 40 mV | 39 dB | 42 dB |
| 45 mV | 38 dB | 41 dB |
| 50 mV | 37 dB | 40 dB |
| 55 mV | 36 dB | 39 dB |
| 60 mV | 35 dB | 38 dB |
| 65 mV | 34.5 dB | 37.5 dB |
| 70 mV | 34 dB | 37 dB |
| 75 mV | 33 dB | 36 dB |

$$SN_{dB} = 20 \log \frac{E_{pk\ video}}{E_{rms\ noise}} \quad \text{but} \quad E_{rms\ noise} = \frac{E_{pk\ noise}}{6}$$

$$= 20 \log \frac{E_{pk\ video}}{\left(\frac{E_{pk\ noise}}{6}\right)}$$

$$20 \log \frac{E_{pk\ video}}{E_{pk\ noise}} + 15\ dB$$

2. Press the DEMOD pushbutton of the waveform monitor and set the RESPONSE switch for DIFF GAIN at 2H SWEEP rate.

3. Adjust the vertical POSITION control to set the top of the chroma subcarrier at 100 IEEE units on the graticule.

4. Press the RECORD and PLAY pushbuttons to make a one-minute recording; rewind to the beginning.

5. Set the ON-OFF toggle switch on the auto chroma PWA to ON.

6. Play back the recording and if necessary, set the UNITY-VARIABLE toggle switch on the auto chroma PWA to VARIABLE, and adjust the CHROMA LEVEL potentiometer so that the subcarrier is 100 on the graticule.

7. Adjust the CHAN 1, 2, 3, and 4 DG controls so that the subcarrier is at 100 on the graticule (see Figure 2-6).

8. Set the ON-OFF toggle switch on the auto chroma PWA to OFF.

9. Adjust the CHAN 1, 2, 3 and 4 EQUALIZATION controls so that the subcarrier on each channel is at 100 on the graticule.

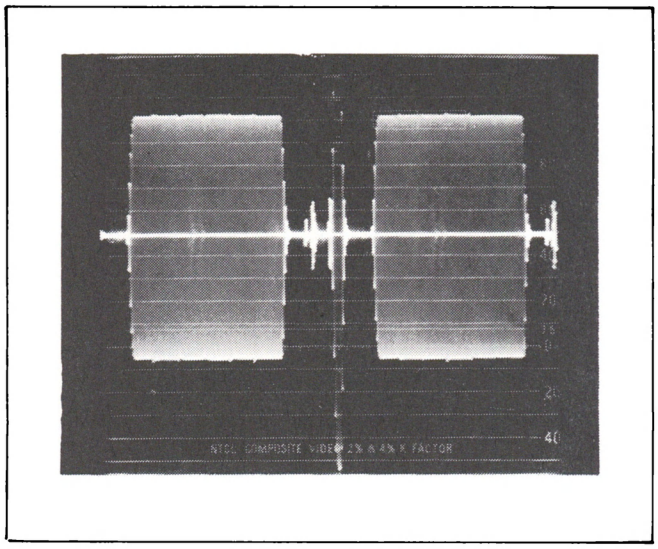


**Figure 2-6. Differential Gain Display**

10. Readjust monitor for normal operation.

**Alternative Differential Gain and Equalizer Adjustment (with Auto Chroma).** An alternative procedure for making differential gain and equalizer adjustments on systems using the auto chroma PWA is as follows:

1. Connect an input of split-field, 75% color bar signals in accordance with the EIA standard RS 189. The chroma, sync, and burst must be at the correct level at the input of the machine to perform the adjustment properly.

2. Press the CHROMA pushbutton of the A-scope. If the sync and burst levels are correct, the burst envelope display should be at the centerline of the scope (see Figure 2-7). If not, adjust scope centering controls so that the signals are at the centerline.

3. Make a one-minute recording and rewind to the beginning.

4. Set the auto chroma PWA (PWA 14) ON-OFF toggle switch to OFF.

5. Play back the recording and adjust the CHAN 1, CHAN 2, CHAN 3 and CHAN 4 EQUALIZATION controls on the maintenance panel so that the burst envelopes for each channel are equal and on the centerline of the A-scope (see Figures 2-7 and 2-8).

6. Set the auto chroma ON-OFF toggle switch to ON; with the UNITY-VARIABLE toggle switch in the UNITY position, the burst envelopes should stay at the centerline of the scope. If necessary, set UNITY-VARIABLE toggle switch on auto chroma PWA to VARIABLE and adjust the CHROMA LEVEL potentiometer so that the subcarrier is at 100 on the graticule.

7. Press the NORMAL pushbutton on the waveform monitor. Set the RESPONSE switch on the waveform monitor to FLAT and the SWEEP rate to 2V.

8. Play back the recording and adjust the CHAN 1, 2, 3 and 4 DG controls so that the subcarrier level for each channel is equal and the yellow bar is at the same amplitude as the white reference pulse on the display (see Figures 2-9 and 2-10).

**NOTE**

**When playing back tapes that may have been recorded on another machine, the differential gain controls may be adjusted to make up for some deficiencies in recording. It is recommended that the adjustment of step 8 be performed while playing back the color bars normally recorded on the tape leader. It is necessary to assume that the color bars were properly set up since it is important for best results in playback that the differential gain of all channels be equal.**

**Differential Gain and Equalizer Adjustment Method for System not Equipped with Auto Chroma Accessory.** A procedure for making differential gain and equalizer adjustments on systems not equipped with an auto chroma accessory is as follows:

1. Connect an input signal to the AVR-2 consisting of a staircase, with exactly 40 IEEE units sync and color burst.

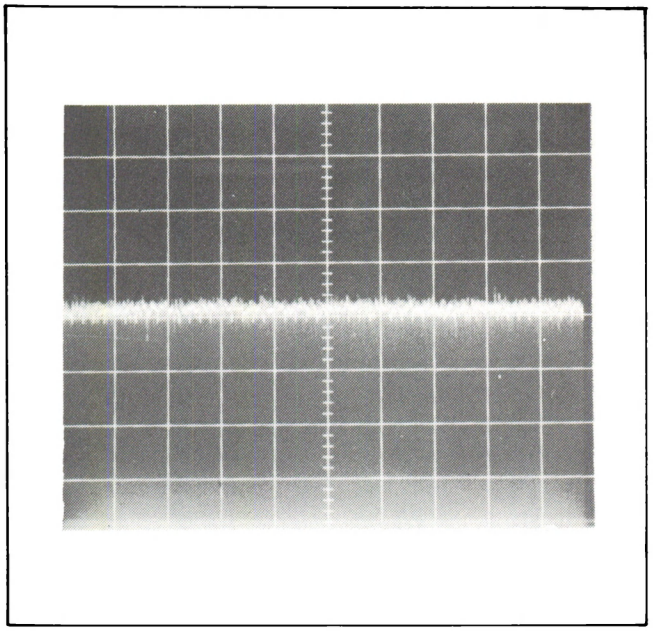


Figure 2-7. CHROMA Display,
Correct Adjustment

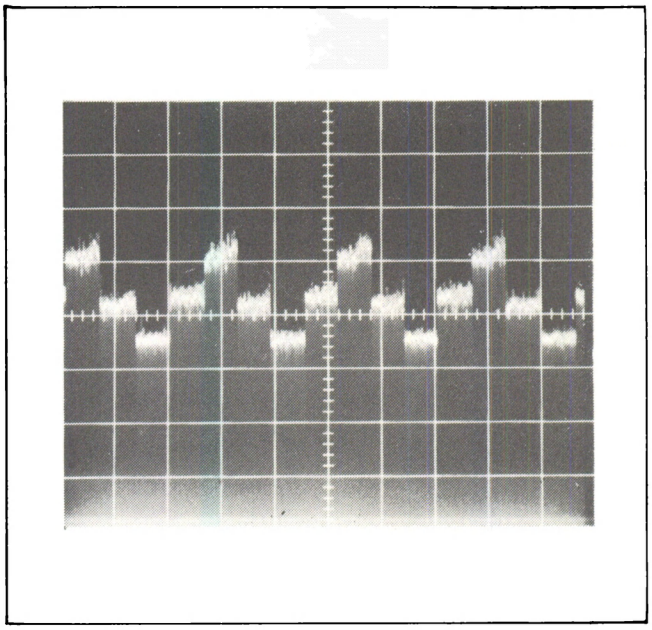


Figure 2-8. CHROMA Display,
Poor Adjustment

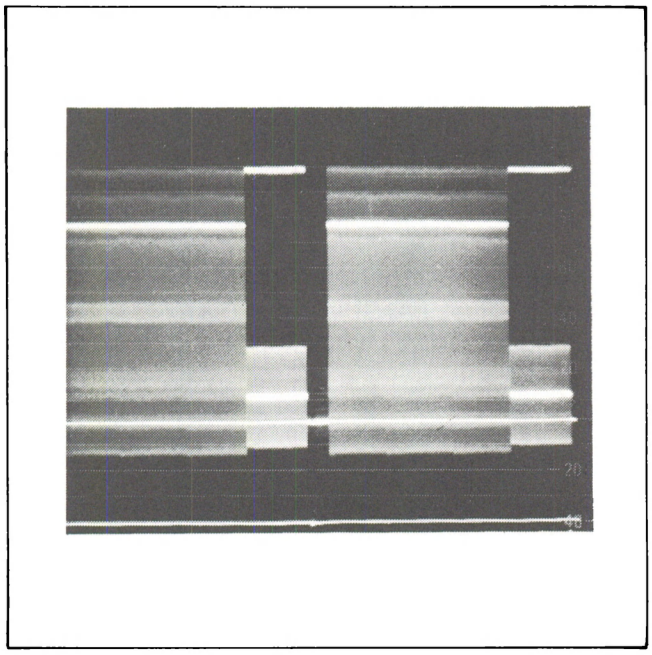


Figure 2-9. NORMAL Display,
Correct Differential Gain Adjustment

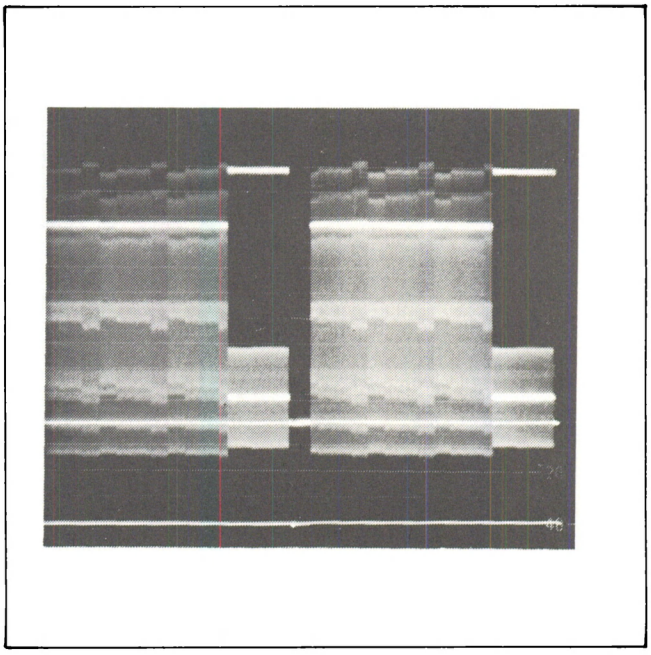


Figure 2-10. NORMAL Display,
Poor Differential Gain Adjustment

2. Press the DEMOD pushbutton of the waveform monitor; set the RESPONSE switch for DIFF GAIN and SWEEP rate at 2H, and adjust the vertical POSITION control to set the top of the chroma subcarrier at 100 IEEE units on the graticule.

3. Make a one-minute recording; rewind to the beginning.

4. Play back the recording and adjust the CHAN 1 DG control, then the CHAN 1 EQUALIZATION control so that its segment of the subcarrier display is flat and at 100 on the graticule (the two controls interact).

5. In a similar manner, adjust the CHAN 2 DG and EQUALIZATION controls, CHAN 3, and CHAN 4, until all segments of the display are flat and at 100 (see Figure 2-6).

### Vacuum Guide Height and Tip Penetration Adjustment

The Ampex standard alignment tape, part no. 1374554 supplied with the AVR-2, should be used to check for standard guide height and tip penetration prior to making each new recording. This will avoid producing a non-standard recording. The alignment tape contains a video test signal and an audio test signal. The video signal consists of alternately black and white vertical bars. Non-standard tip-to-tape engagement causes skewing and/or scalloping of the bars as seen on the picture monitor. The vacuum guide height and tip penetration adjustment procedure is as follows:

**CAUTION**

**DO NOT ATTEMPT TO ADJUST THE VACUUM GUIDE FOR STANDARD TIP PENETRATION BY OBSERVING THE RF LEVEL WAVEFORM ON THE WAVEFORM MONITOR. DURING PLAYBACK, A FLAT RESPONSE OBSERVED ON THE WAVEFORM MONITOR DOES NOT INDICATE A STANDARD TIP PENETRATION. TIP PENETRATION SET FOR FLAT RESPONSE AS OBSERVED ON THE WAVEFORM MONITOR WILL RESULT IN SEVERELY DECREASED HEAD LIFE.**

1. Turn on the system power and thread the standard Ampex alignment tape on the tape transport.

2. Press in the REC/PLAY lever (see Figure 2-11), turn it clockwise to the REC position and release it.

3. Initiate the play mode and observe the video monitor to determine if any skewing is present (see Figure 2-12).

4. If any skewing is present, eliminate it by adjusting the coarse adjustment screw at the right side of the tape guide plate.

5. If the monitor shows any scalloping (see Figure 2-13), adjust the height control to eliminate it.

6. If skew is evident (see Figure 2-12), set REC/PLAY to PLAY and adjust tip penetration knob (Figure 2-11) to obtain minimum skew indication. After tape has been played, return REC/PLAY lever to REC.

## CONTROL TRACK HEAD POSITION ADJUSTMENT

The position of the control track head is factory-set and normally will not require resetting. However if the original position has been disturbed, it may be restored by the following procedure:

1. Verify that the manual tracking and capstan drive PWA, or auto tracking and capstan drive PWA, has been set up properly.

2. Play back a standard alignment tape (Ampex Part No. 1374554).

3. Select R.F. LEVEL on the waveform monitor.

4. Slightly loosen the holddown screw that secures the control head bracket.

5. Adjust the eccentric screw nearest the tape path to move the head upstream or downstream as necessary for maximum rf signal as seen on the waveform monitor.

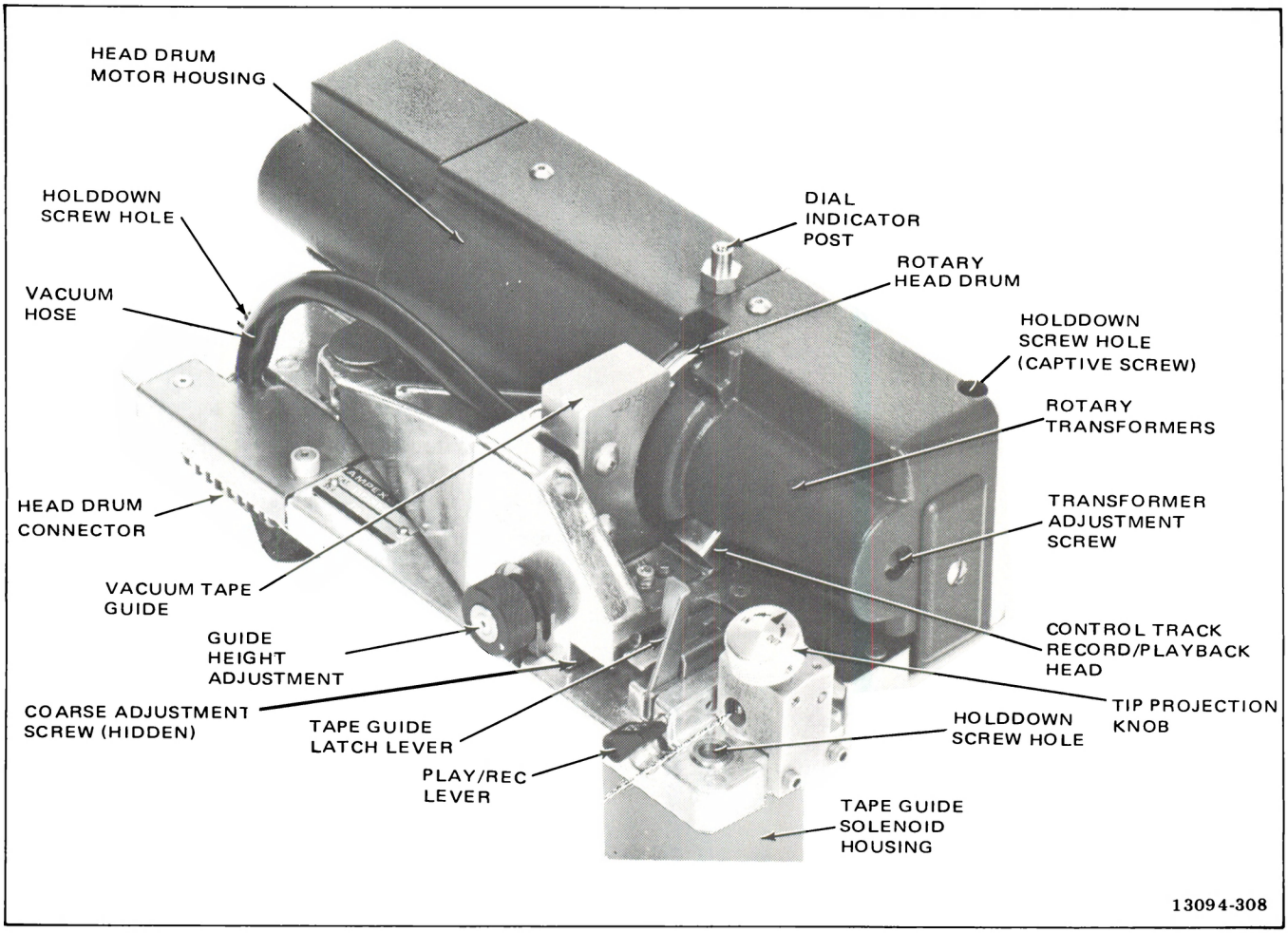



Figure 2-11. Mark XV Head Assembly

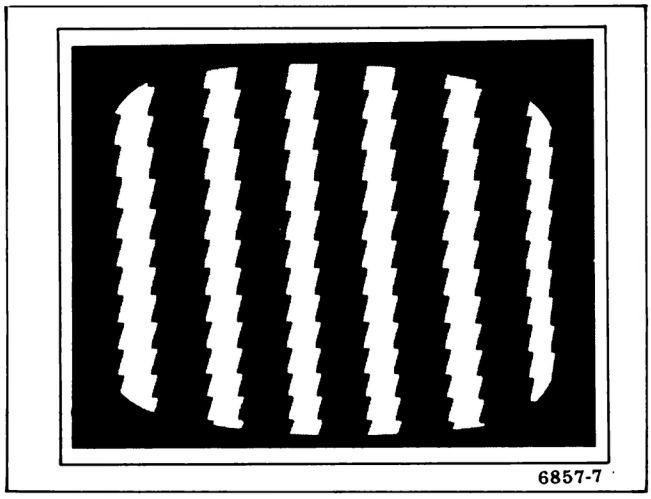



Figure 2-12. Picture Skewing of Vertical Bar Test Signal

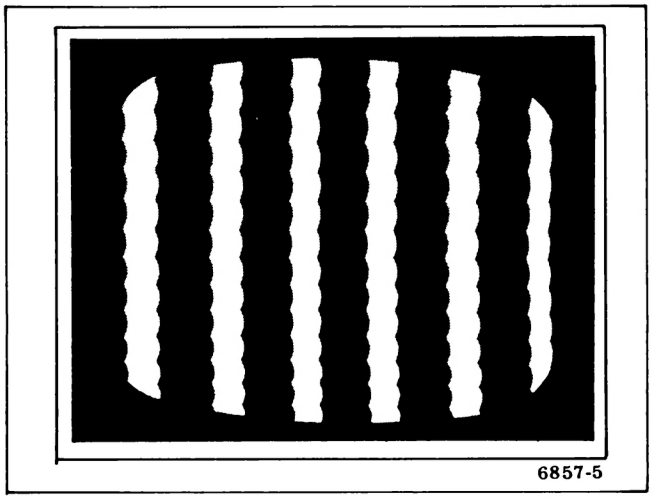



Figure 2-13. Picture Scalloping of Vertical Bar Test Signal

6. Correct the placement of the recorded control track signal at the edge of the tape by adjusting the second eccentric screw for maximum rf signal on the waveform monitor.

7. Tighten the holddown screw loosened in step 5.

### Video Head Degaussing

Degauss the video heads as follows.

**CAUTION**

**THE SYSTEM MUST BE TURNED ON AND SUPPLYING AIR TO THE AIR BEARING IN THE VIDEO HEAD ASSEMBLY. ENSURE THAT THE BEARING AIR INDICATOR IS NOT LIGHTED. DO NOT MOVE THE HEADWHEEL IF BEARING AIR IS NOT BEING SUPPLIED.**

1. To prevent scratching the head surfaces, cover demagnetizer pole tips with a piece of tape.

2. Set the READY toggle switch to OFF and ensure that the video head is not rotating.

3. Unlatch and swing the vacuum guide away from video headwheel.

4. Manually rotate the video headwheel to position one of the head tips for easy access.

5. With the demagnetizer as far away from the equipment as possible, plug demagnetizer power cord into a 115-volt outlet.

6. Move the demagnetizer slowly and evenly toward the exposed video head tip. Straddle the head gap with demagnetizer pole tips, allowing them to touch the head tips lightly (see Figure 2-14).

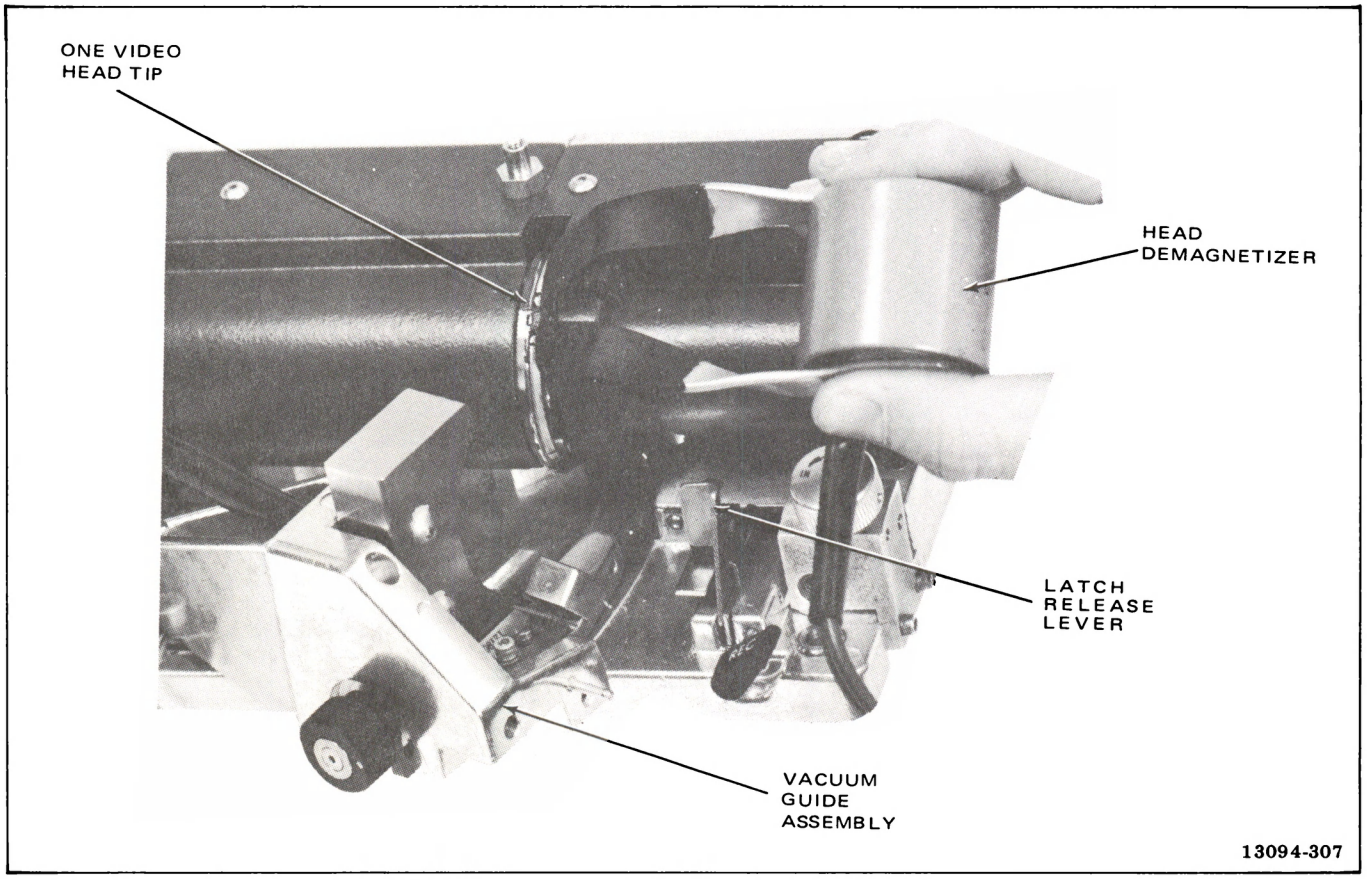



**Figure 2-14. Degaussing a Video Head Tip**

7. Hold the demagnetizer in this position for approximately three to five seconds, and then withdraw it slowly and evenly from head tip, in the opposite direction from the approach.

8. Move the next head tip into an accessible position and repeat steps 6 and 7. Perform the degaussing procedure for each of the head tips.

### Control Track Record/Reproduce Head Degaussing

Degauss the control track record/reproduce head as follows:

1. Move the demagnetizer slowly and evenly toward the control track record/reproduce head. Straddle the head gap with demagnetizer pole tips allowing them to touch head lightly.

2. Hold demagnetizer in this position for approximately 15 seconds. During this period, slowly move demagnetizer pole tips up and down the length of the head gap.

3. Withdraw demagnetizer slowly and evenly from head gap along same path used for the approach.

### Audio and Cue Head Degaussing

Degauss the audio and cue head by applying the procedure used for the control track record/reproduce head to the audio and cue head.

### Audio and Control Track Monitor Head Degaussing

Degauss the audio and control track monitor head (if this option is part of the system) by applying the procedure used for degaussing the control record/reproduce head to the audio and control track monitor head.

# SECTION 3
# CORRECTIVE MAINTENANCE

Procedures required for troubleshooting and performing service adjustments to re-establish normal operation are given in this section. The procedures are divided into the following major groups:

Power Supplies
Transport System
Audio and Cue System
Servo System
Video Signal System
Time-Base Corrector
Editor

## PWA FUNCTION SUMMARY

The functions of the PWAs in the electronics assembly are summarized in Table 3-1.

## WAVEFORMS (WAVEFORM MONITOR)

The waveform monitor on the monitor bridge assembly can be used to check key points in the system. Representative waveforms are shown in Figure 3-1.

## ELECTRONICS ASSEMBLY PWA LOCATION

The locations of the PWAs in the electronics assembly are shown in Figure 3-2.

## JUMPERS

Many PWAs used in the AVR-2 contain jumpers. A jumper is a length of wire or link that plugs into the component side of the PWA and electrically connects two points of the PWA's circuitry. Some jumpers may be set in two or more positions while others may only be plugged in or removed. They alter circuit operation by including or bypassing portions of the PWA's circuitry. Many jumpers are used to alter the circuit to provide convenient test or alignment configurations of the circuit. Others provide the operator with alternative modes of system operation. Table 3-2 lists all of the jumpers used on the AVR-2's PWAs. The various positions in which the jumpers may be placed are given for each. Jumper placement for normal circuit operation is indicated. The effect on circuit operation of placing the jumpers in their alternative positions is also indicated.

**Table 3-1. Summary of PWA Functions**

| PWA | FUNCTION |
|---|---|
| 1 Tracking and Capstan Drive | 1. Adjusts phase of head tach supplied to capstan 240-Hz phase comparator (playback only) to maximize rf in either auto tracking or manual modes.<br>Auto tracking uses rf envelope to sense when video transducers are centered on track.<br>2. Sequence generator generates time slots, in playback, when head and capstan servo can use specific references.<br>Sequences are detailed on schematic.<br>3. Logic to generated SERVO LOCK command: put out servo lamp on control panel.<br>READY: Headwheel phase and speed loops locked.<br>RECORD: "Ready" plus capstan under control; headwheel maintaining phase loop within ±5 μs.<br>PLAYBACK: Head phase and speed loop locked, vertical coincidence ±30 μs, framed in 3-ms window, capstan servo stable. |

Table 3-1. Summary of PWA Functions (Continued)

| PWA | | FUNCTION |
|---|---|---|
| 1 | Tracking and Capstan Drive (Continued) | 4. Capstan drive function maintains speed of capstan by comparing capstan tach with capstan oscillator. |
| 2 | Capstan Servo | 1. Logic to control servo errors to capstan oscillator generates control commands:<br>NORMAL: Playback, use framing of control track vs head tach comparators to determine capstan speed.<br>240: In record mode, compare head tach vs capstan oscillator ÷ 10 to control capstan speed.<br>STANDBY: DC voltage from ASSEMBLE SPEED potentiometer controls oscillator. Primary function assemble record.<br>2. 240/250-Hz phase comparator.<br>3. Frame phase comparator - gets frame lock in 3-ms window and generates frame lock command.<br>Not Analog - speed up to 15.5 in/s or down to 14.5 in/s.<br>4. Tape speed override (TSO) oscillator, to vary tape speed when machine controlled by RA-4000 or other computer type external editor.<br>5. Capstan frequency synthesizer (capstan oscillator) produces 2400/2500-Hz output.<br>6. Speed control - basically using oscillator output (15 in/s), oscillator ÷ 2 (7-1/2 in/s), oscillator ÷ 4 (VHO), or TSO.<br>7. Switch on front panel selects 7-1/2/15 in/s.<br>8. Control sets assemble record speed of capstan. |
| 3 | Control Track and Sync Processor | 1. Processes control track for record and playback, 240/250-Hz and 30/12.5-Hz information.<br>2. Control track record level control on PWA cover.<br>3. Decodes input sync (from modulator video) and reference sync (from sync generator PWAs 29/30) into:<br>25/30-Hz component<br>12.5-Hz component (625 only)<br>15-Hz component (PAL M only)<br>50/60-Hz components<br>H rate (15-Hz component)<br>4. Decodes sync stripped from demod sync video into:<br>50/60-Hz component<br>25/30-Hz component<br>12.5/15-Hz component (PAL/SECAM systems)<br>5. Servo portion of color framer logic generates EDITOR ON bus in playback position of color framer switch under certain conditions.<br>6. 10-MHz reference clock for servos. |
| 4 | Head Phase Comparator | 1. 50/60-Hz phase comparator.<br>2. 15-kHz phase comparator (H lock).<br>3. Delays for normal playback. |
| 5 | Head Driver | 1. Auto phasing (compensation for dc motor characteristics).<br>2. Frequency discriminator (speed or velocity damping loop).<br>3. Detection and compensation for nonstandard (wrong phase) control track.<br>4. Processing of headwheel tachometer signals.<br>5. Headwheel summing amplifier (speed, position, and auto-phasing error control voltages).<br>6. Basic signal system switcher waveforms. |

**Table 3-1. Summary of PWA Functions (Continued)**

| PWA | FUNCTION |
|---|---|
| 6 Control Logic | 1. Controls E-E bus, jumper determines action of E-E/TAPE switch audio only or audio video.<br>2. Generates tape movement commands.<br>3. Basic record commands.<br>4. Video edit record delays. |
| 7 Editor | 1. Upon receipt of edit command, provides correct turn on/off timing of video/audio erase, video/audio record, accounting for physical dimensions of tape transport.<br>2. Provides test switch for EDITOR ERASE SET-UP and VIDEO ERASE timing control.<br>3. Permits manipulation of edit timing on the basis of recovered prerecorded edit tones.<br>4. Cue tone playback preamp.<br>5. Test switch generates 4 frame edits. |
| 8 Cue | 1. Permits recording and erasure of 4-kHz edit tones as commanded by editor PWA 7.<br>2. Microphone preamplifier.<br>3. Cue track RECORD/PLAYBACK. |
| 9 Audio 1 | 1. Standard single audio.<br>2. Audio monitor logic.<br>3. Editor controlled logic functions.<br>4. Bias/erase oscillator for PWAs 8, 9, 10. |
| 10 Audio 2 | 1. Used only in stereo/dual audio options. Stereo audio, one erase; dual audio, dual erase.<br>2. Same as and interchangeable with PWA 9.<br>3. All audio PWAs have record and playback level controls variable or preset. |
| 11 Power Supply Regulator | 1. ±12V<br>2. +5V<br>3. +5V TBC<br>4. -5.2V<br>5. ±24V<br>6. ±12V Reference |
| 12 Modulator | 1. Input video distribution amplifier, clamp generation, and input video gain control.<br>2. Sync stripper. Provides input sync to servo.<br>3. Modulator produces 7–10-MHz fm signal.<br>4. Automatic frequency control for modulator at blanking frequency.<br>5. Source of E-E rf.<br>6. Record gate controlled by:<br>Master Record<br>Editor RF Gate<br>VHO (Video Head Optimize) Gate |
| 13 Monitor Switcher/ Color Framer | 1. Control monitoring:<br>Input to TRACKING METER<br>Rectifies off-tape RF envelope playback, VHO<br>Peak video level in E-E<br>Input to WFM depending on button pressed on monitor switch panel.<br>Video input to video monitor.<br>2. Selects VHO record gate depending on setting of VHO selector switch. |

**Table 3-1. Summary of PWA Functions (Continued)**

| PWA | FUNCTION |
|---|---|
| 13 Monitor Switcher/ Color Framer (Continued) | 3. Pulse forms and adds to video stability marker (STAB DOT) representing relationship of video head 4 and video signal.<br>4. Selects video reference source to sync generator.<br>5. Controls conditions under which output video is held in black. Jumpers select conditions.<br>6. Compares input sync/burst relationship with demod sync/burst relationship to determine if machine color framed to modulator input video. |
| 14 Auto Chroma | 1. Measures amplitude of burst with respect to sync on the demod video sync signal and sends voltage to control rf path equalizer (frequency vs amplitude)on PWA 15.<br>2. CHROMA LEVEL control permits compensation for non-standard tapes (burst low or high with respect to sync).<br>3. Generates Mono/Color bus used by color framer. |
| 15 RF Switcher and Equalizer | 1. In a two-step process, combines the rf from four heads, in playback, into one continuous signal, eliminating redundant information.<br>Timing information at 960/1000-Hz rate from servo of head location is combined with horizontal rate information from demodulators to perform switch.<br>2. Uses switcher waveforms to develop four channel switch waveforms each at 240/250-Hz rate, synchronized to identify time when a particular head is on tape.<br>Used by VHO logic as an individual channel record bus.<br>Used by auto chroma to identify head on tape for DG and rf equalizer time sharing.<br>3. Provides two rf signal paths.<br>Sync video rf switched 12μs early with respect to horizontal sync edge.<br>Demod video rf switched 2μs after leading edge of sync.<br>No Switch Time protection.<br>4. Provides rf equalization of demod video rf, controlled by either manual equalizer controls or auto chroma control.<br>5. Provides differential gain equalization of the signal for non-standard – incorrectly optimized – recordings. |
| 16 Demodulator | 1. Selection of modulator E-E rf or playback rf from PWA 15.<br>2. Limiting of sync and demod video rf.<br>3. Detection of rf dropout or loss of all rf.<br>4. Detection – demodulation of both rf signals.<br>5. From detected sync video rf:<br>Composite sync to servo<br>Tape H – leading edge of sync – to servo and TBC for all H rate timing correction.<br>Drive for video level meter in E-E/Record.<br>Sync video to auto chroma to provide sync level reference.<br>RF switch timing.<br>6. From detected demod video rf:<br>Demod video<br>Tape burst for the auto chroma<br>RF switch timing |

**Table 3-1. Summary of PWA Functions (Continued)**

| PWA | | FUNCTION |
|---|---|---|
| 17 | Input Video (TBC) | 1. Processes demod video for use in time-base corrector.<br>Inserts reference dc level on tip of sync.<br>Inserts burst in a monochrome signal.<br>Amplifies and level shifts burst on a color signal.<br>With test jumper inserts sawtooth for 52$\mu$s of picture time.<br>2. Processes dropout signal from demod PWA 16.<br>3. Identifies dropout occurring during horizontal blanking and extends it to one full line in length to prevent sampling signal with noise on back porch instead of tape burst.<br>Sends dropout flag pulse to velocity compensator when dropout is in sync to inhibit measurement.<br>4. Identifies signal as mono or color.<br>5. Provides gating pulses to indicate time when burst is occurring on signal.<br>6. Black level control of output video. |
| 18 | Analog to Digital Converter "A" (A/D "A") | 1. Matched and serialized to PWA 19.<br>2. In sample and hold circuit, samples signal level at 3 times subcarrier rate. After times 4 amplifier.<br>3. Sampled signal voltages compared against reference voltage divider and converts to binary number which identifies instantaneous voltage of signal in 250-mV steps.<br>4. Sample and clamp signal to PWA 19. |
| 19 | A/D "B" | 1. Converts binary number from PWA 18 back to video (digital to analog converter) and subtracts this from sampled video from PWA 18.<br>2. Result is amplified and then compared against reference voltage divider which identifies instantaneous value of signal voltage in 62 mV steps, and converts to 4-bit binary number.<br>3. Output of PWA is 8-bit number, representing the instantaneous signal level of the signal. Three 8-bit binary numbers represent information in 280 ns of the signal (one cycle of subcarrier on a color signal). |
| 20 | Clock Generator | 1. Generates 3.58/4.43-MHz TTL level square wave clock from reference subcarrier out of sync generator.<br>Subcarrier phase control determines phase of output signal.<br>2. Generates 3 times subcarrier clock, to sample signal.<br>3. Generates tape 3.58/4.43-MHz clock from information of burst store memory (PWA 21).<br>4. Generates 3 times subcarrier clock, to sample signal.<br>5. Electronic switch selects reference 3 times subcarrier during burst time as sample clock to PWA 18/19.<br>6. On PAL systems, removes 90° phase shift of tape burst using 7.8-kHz derived on PWA 28.<br>7. On PAL systems, provides 90° phase shift to subcarrier from sync generator at 7.8-kHz rate for output video PWA burst adder. |
| 21 | Burst Store Generator | 1. During burst time, writes 8-bit numbers coming out of PWA 19 into random access memory – stores information representing 5 cycles of burst – fifteen 8-bit words.<br>2. Until burst occurs again, addresses memory and reads out same numbers in same order, and applies to digital to analog converter, creating a continuous regenerated tape burst subcarrier type signal during the line.<br>3. Converts the 8-bit binary numbers from PWA 19 clocked at 3 times subcarrier to 24-bit number clocked at subcarrier (3.58/4.43) rate. |

Table 3-1. Summary of PWA Functions (Continued)

| PWA | | FUNCTION |
|---|---|---|
| 21 | Burst Store Generator (Continued) | 4. Retimes the signal, originally sampled by regenerated tape to reference subcarrier.<br>5. Output of board is 24-bit word whose timing difference with respect to reference is in whole cycles of subcarrier. |
| 22 | 256-Word Memory/ 512-Word Memory | 1. Selectively stores and retrieves binary information representing one full line, at least. In 525 line systems, about 228 24-bit numbers represent the information on one TV line.<br>2. As determined on logic PWA 28, stores for about 1/2 H. Signal out is timed to reference H. |
| 23 | Two Line Delay (Optional) | 1. Delays signal for two lines, using shift registers.<br>2. On dropout, recirculates output of shift registers back to input, repeating information until dropout disappears. |
| 24 | Main D/A | 1. Converts signal from 24-bit binary number to 8-bit binary number.<br>2. Converts 8-bit binary number, at 3 times subcarrier clock sample rate, to analog signal.<br>3. Inserts new blanking.<br>4. Provides video muting on command from PWA 13.<br>5. Video level control.<br>6. Applies velocity error correction by shifting of subcarrier and 3 times subcarrier clocks in direction to oppose shift of chrominance information caused by velocity error. |
| 25 | Output Video | 1. Filters resampled signal from PWA 24.<br>2. Clips and restores dc level.<br>3. Adds new composite sync, and burst on color signal.<br>4. Provides two outputs (one can be non-composite with jumper) and monitor output to PWA 13. |
| 26 | Velocity Compensator 1 | 1. Develops necessary timing waveforms to measure and store velocity error.<br>2. Stores velocity error voltage until needed.<br>3. Provides control of chroma phase.<br>4. Output to PWA 13 TBC Error. |
| 27 | Velocity Compensator 2 | 1. Stores memory of previous line burst.<br>2. Compares phase of stored previous line burst to burst currently in burst store generator (PWA 21) – to determine velocity error.<br>3. Shifts phase of reference subcarrier used as clock in main D/A (PWA 24) by amount controlled by chroma phase control and velocity ramps. |
| 28 | Logic | 1. Measures time between tape burst crossing and reference subcarrier crossing in increments of 1/8 subcarrier to provide control to PWA 21 of Read/Write cycle on retiming of signal to ref subcarrier.<br>2. Measures time between tape horizontal and reference horizontal in increments of cycles of burst, and provides memory control word to PWA 22, which delays signal approximately 1/2 H.<br>3. Correlates retiming of signal to reference subcarrier and timing of signal to reference H to maintain correct H sync/subcarrier relationship at machine out – usually called sync feedback in AVR-1/VR-1200/VR-2000. |

Table 3-1. Summary of PWA Functions (Continued)

| PWA | FUNCTION |
|---|---|
| 30 Sync Generator | 1. In gen lock condition, locks 3.58-MHz and 80 times H oscillators to selected video reference or modulator input as controlled by PWA 13 jumpers and system commands.<br>2. Uses sync generator chip to produce sync outputs.<br>3. Generates VITS unblanking for field 1/field 2 as selected by jumpers.<br>4. Has an 80 times H LC oscillator where looser lock is required, as well as provisions for locking subcarrier oscillator to 80 times H oscillator on monochrome operation.<br>5. Has optional accessory of precision crystal oscillator.<br>6. Provides horizontal timing adjustment. |

Table 3-2. Jumpers

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 1 Manual Tracking & Capstan Drive | J1 | A - B | Factory test. Capstan motor will run on a choice of Play or Capstan Run command. |
| | | B - C | NORMAL – follows Capstan Run command. |
| PWA 1373112 | J2 | A - B | NORMAL – Freezes sequence register. |
| | | B - C | Factory Test. Forces register to any sequence selected by J3. |
| | J3 | A - E | NORMAL – choice of reset point on sequence register. |
| | | B - E | Factory Test. Selects sequence cycle 2. |
| | | C - E | Factory Test. Selects sequence cycle 3. |
| | | D - E | Factory Test. Selects sequence cycle 4. |
| | J5 | A - B | NORMAL |
| | | Removed | Removed for factory test (measures capstan servo bandwidth). |
| 1 Auto Tracking & Capstan Drive (optional) | J1 | A - B | NORMAL |
| | | Removed | Removed for factory test (measures capstan servo bandwidth). |
| PWA 1373298 | J3 | A - E | NORMAL – register in normal sequence. |
| | | B - E | Factory Test. Selects sequence cycle 2. |
| | | C - E | Factory Test. Selects sequence cycle 3. |
| | | D - E | Factory Test. Selects sequence cycle 4. |
| | J4 | A - B | NORMAL |
| | | B - C | Factory Test. Forces register to any sequence selected by J3. |
| | J5 | A - B | NORMAL – Capstan motor runs on Play command. |
| | | B - C | Capstan motor runs on Capstan Run command. |
| | J6 | A - B | NORMAL |
| | | Removed | Removed for factory test (measures auto tracking servo loop bandwidth). |
| | J7 | A - B | NORMAL |
| | | B - C | Factory Test. Dithers capstan in manual mode for tracking setup. |
| 2 Capstan Servo PWA 1373150 | J1 | A - B | NORMAL |
| | | B - C | Test – forces up frequency count. |
| | | Removed | Remove when J2 is B - C (down frequency). |
| | J2 | A - B | NORMAL |
| | | B - C | Test – forces down frequency count. |
| | | Removed | Remove when J1 at B - C (up frequency) |
| | J3 | A - B | NORMAL |
| | | B - C | Required when J1 or J2 are at B - C. |
| | J4 | A - B | NORMAL - framing bias reference. |
| | | Removed | Removes framing bias from servo loop. |

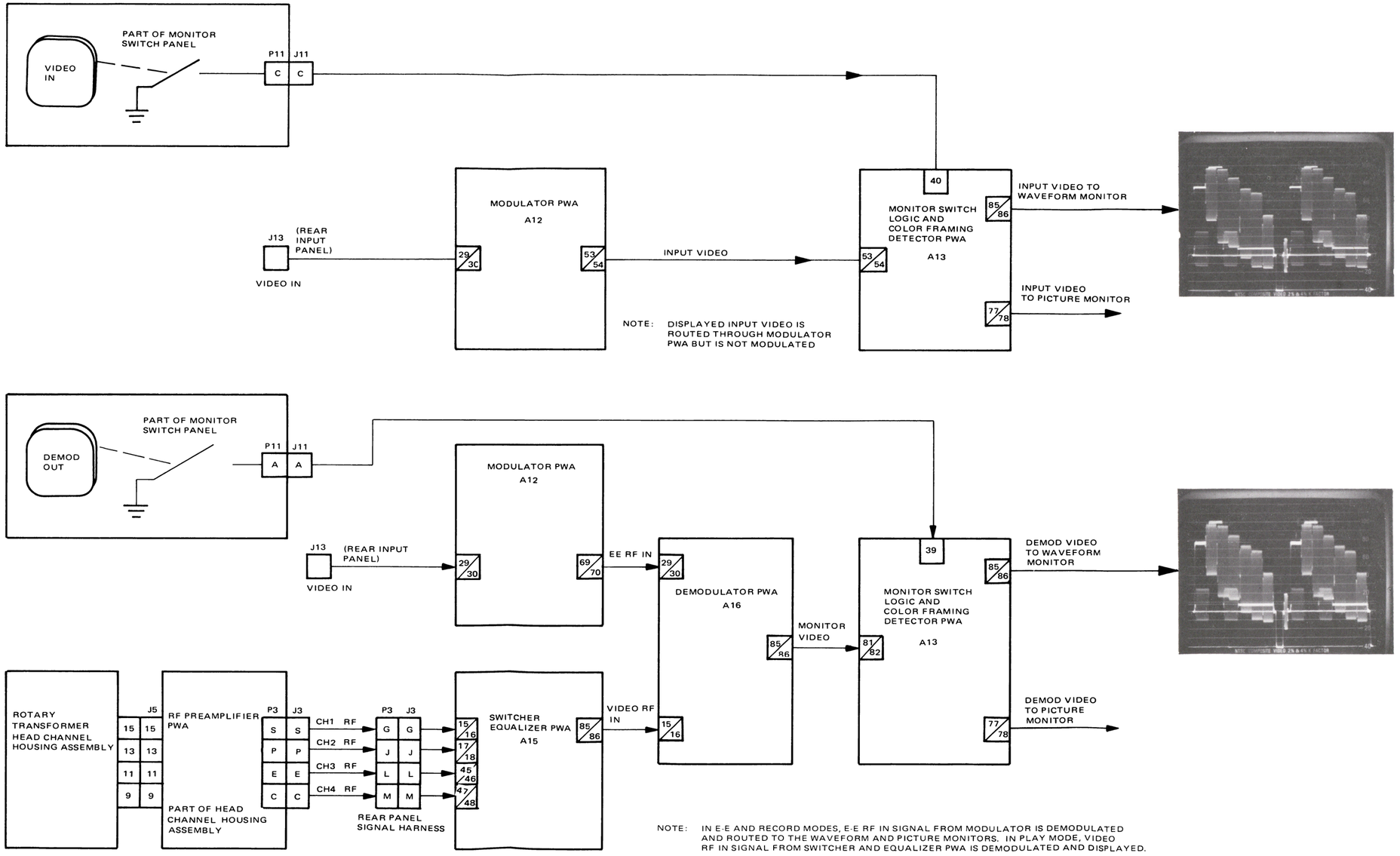



Figure 3-1. Typical Monitor Signals (Sheet 1 of 7)

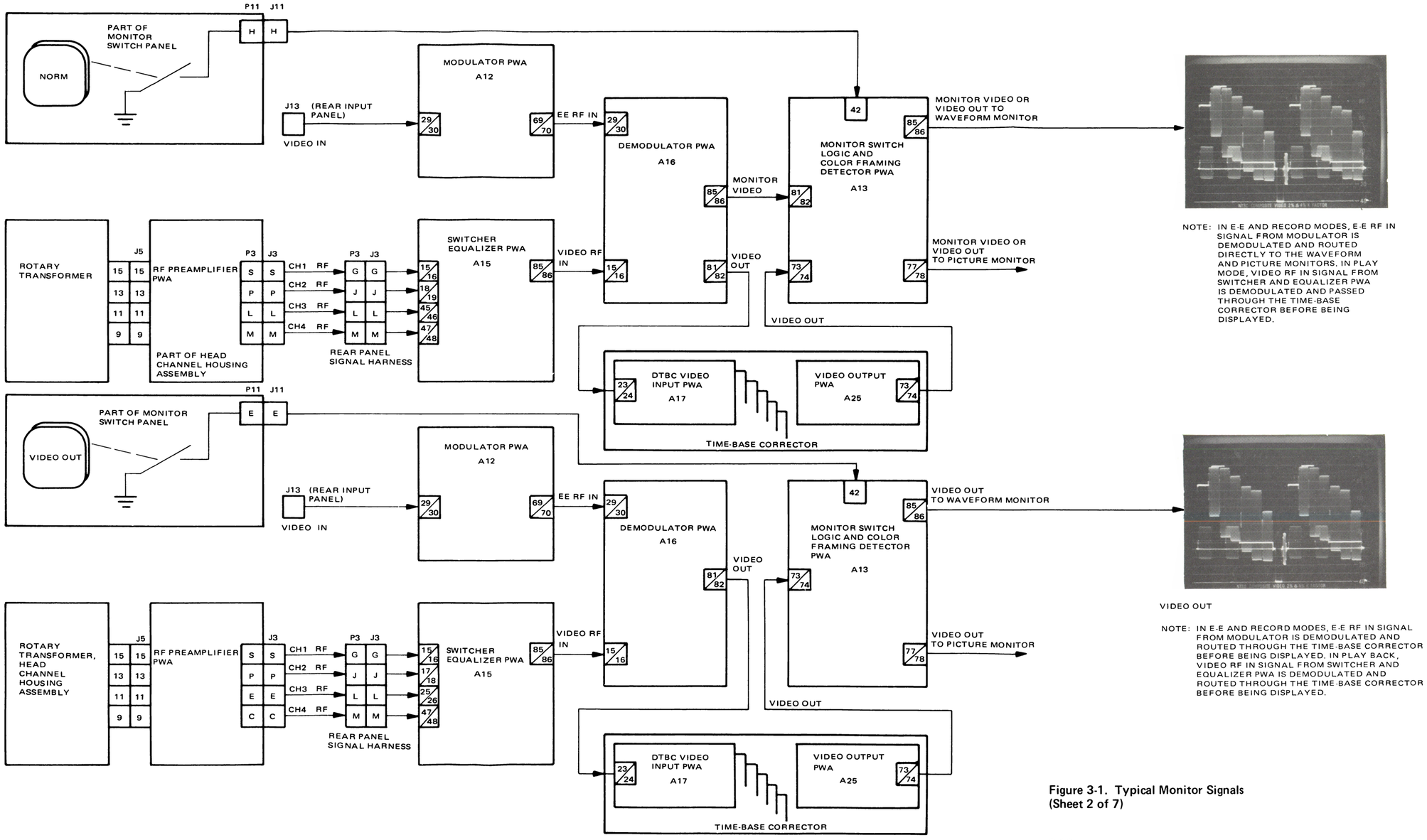



Figure 3-1. Typical Monitor Signals
(Sheet 2 of 7)

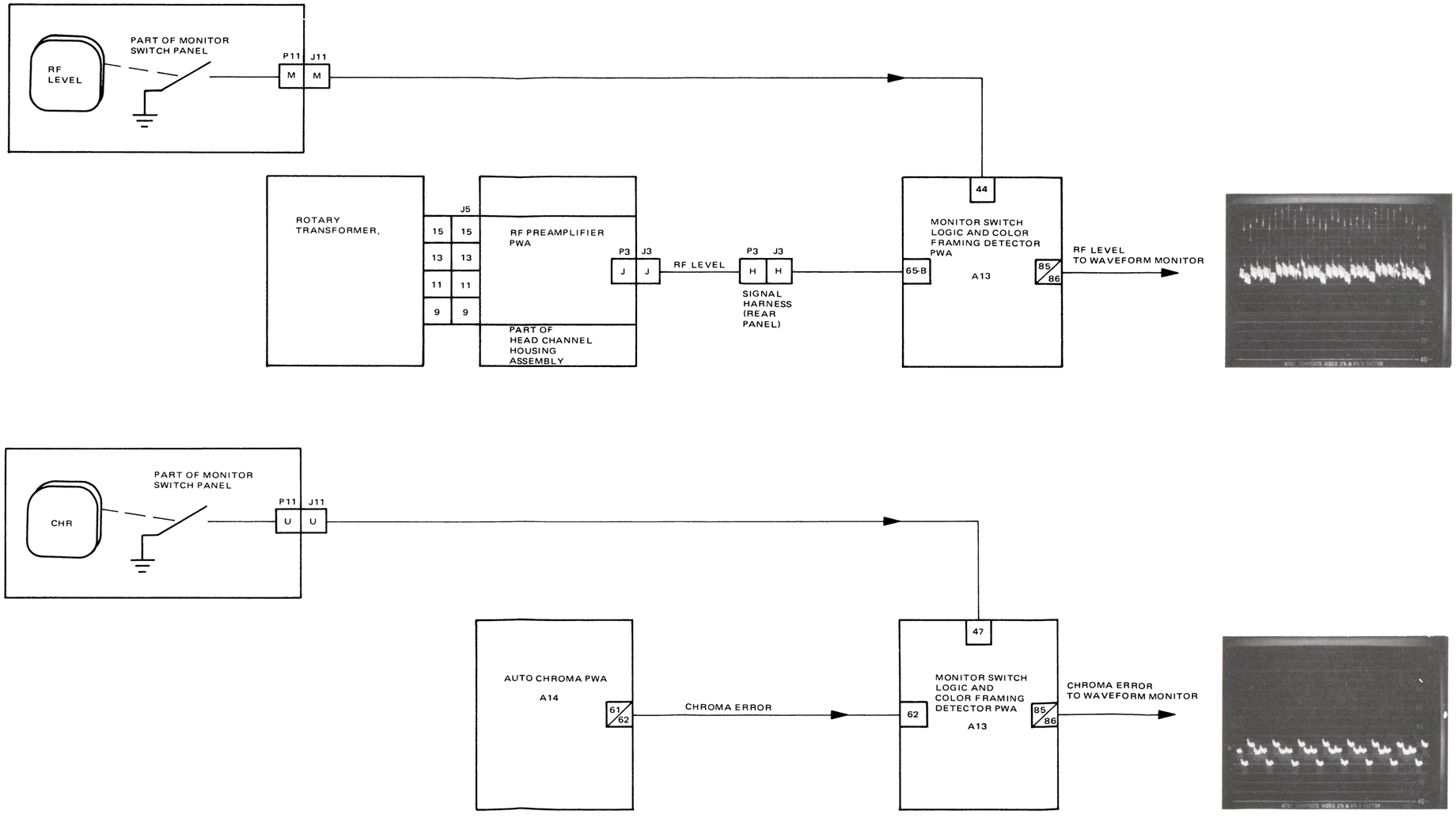



Figure 3-1. Typical Monitor Signals (Sheet 3 of 7)

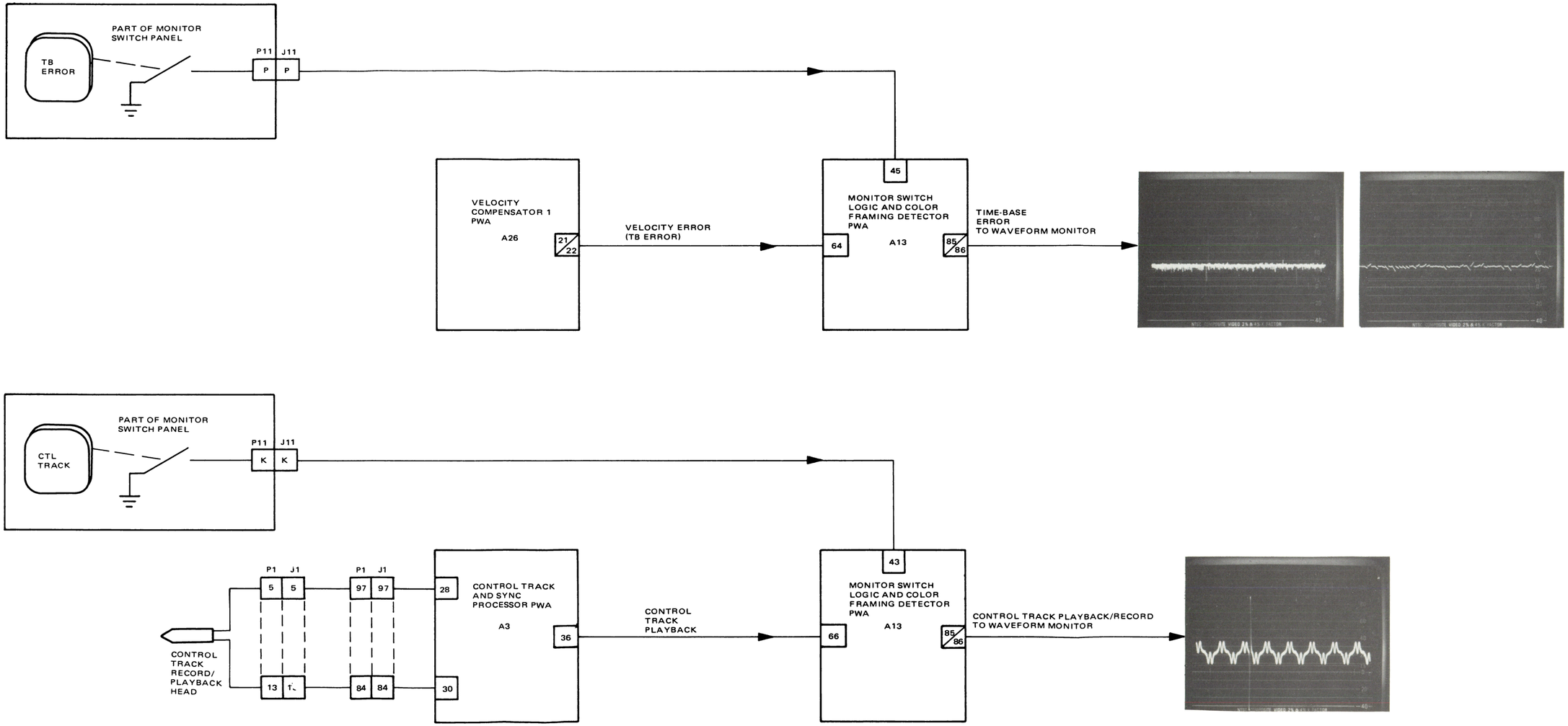



Figure 3-1. Typical Monitor Signals
(Sheet 4 of 7)

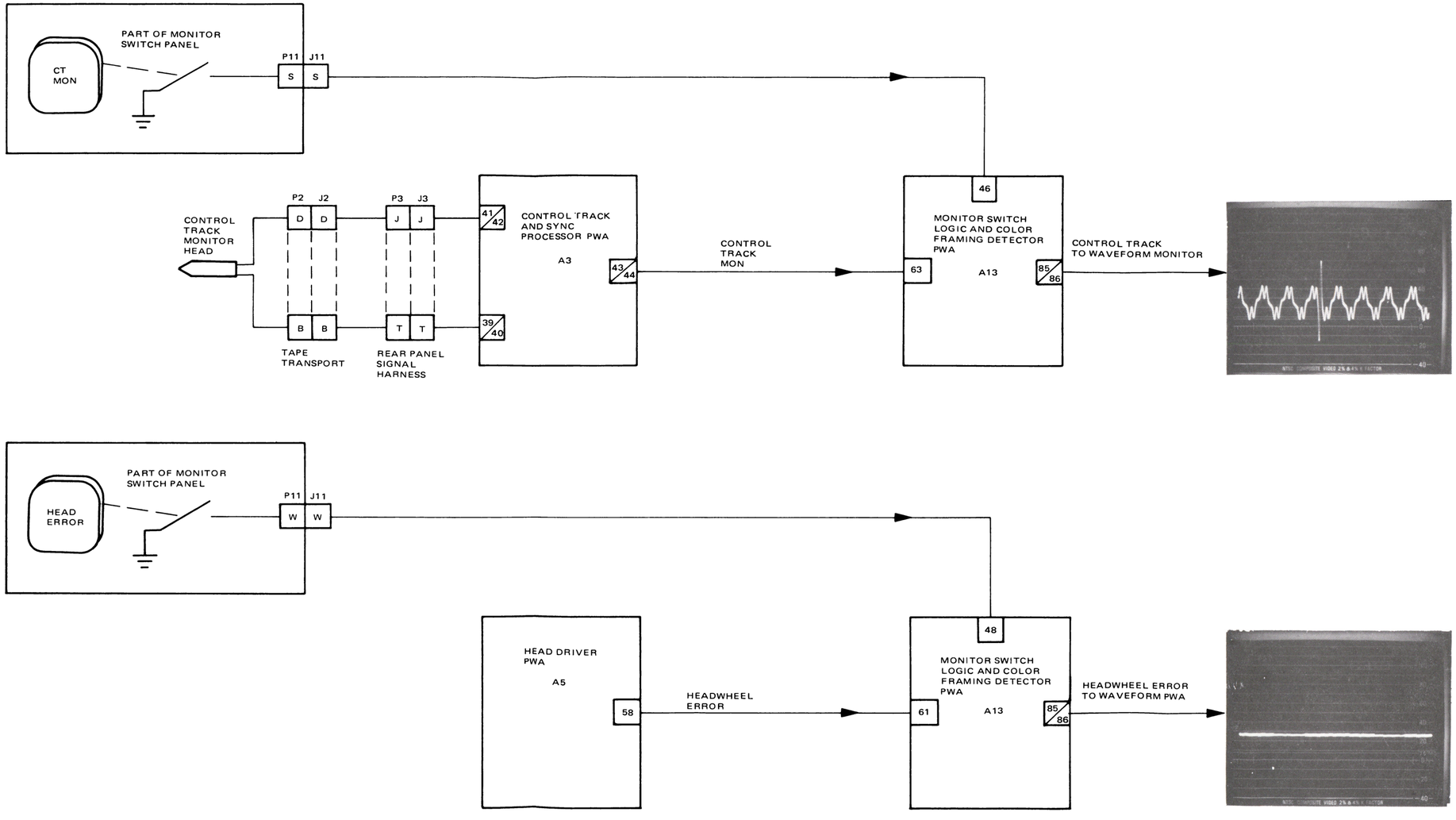
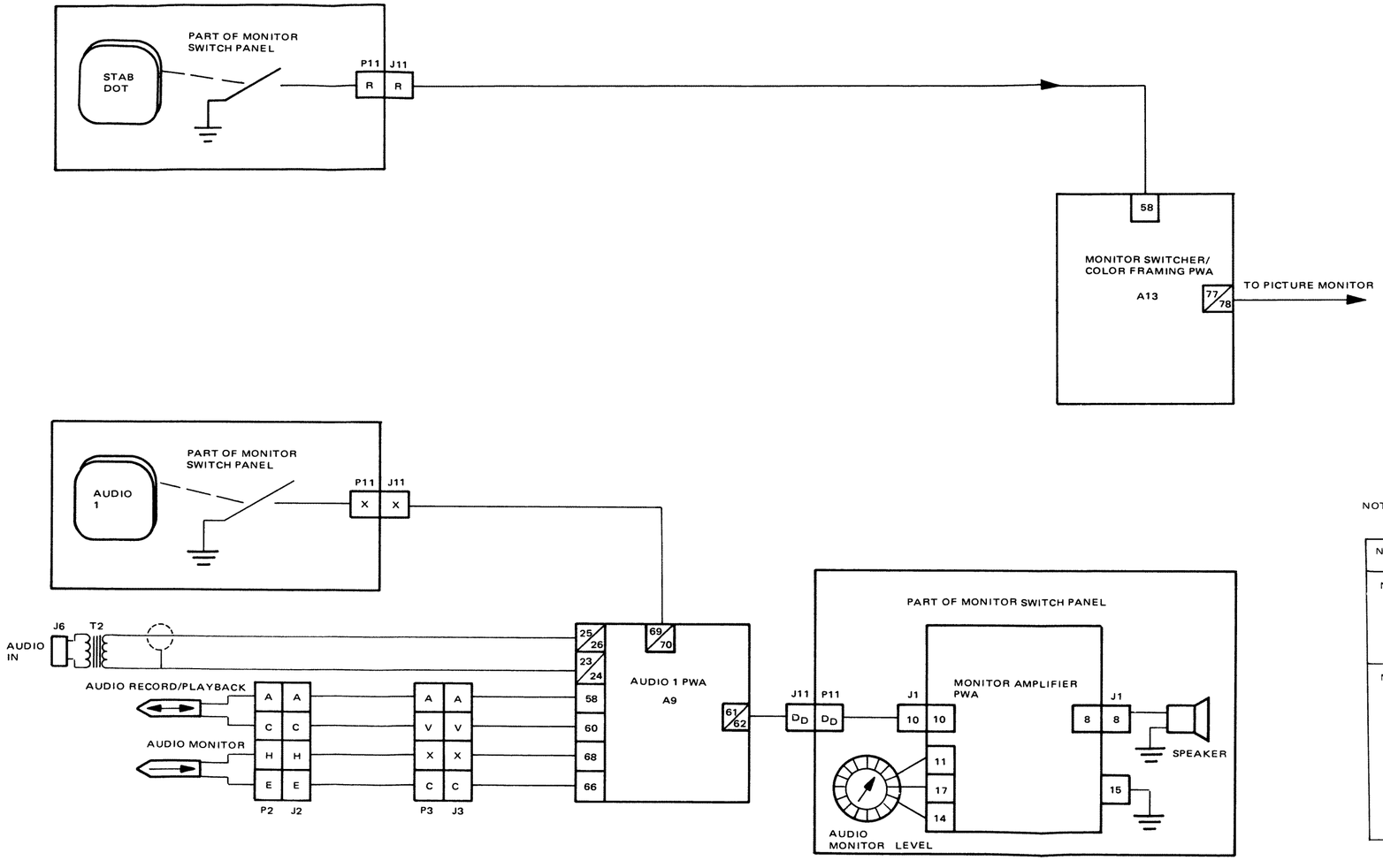


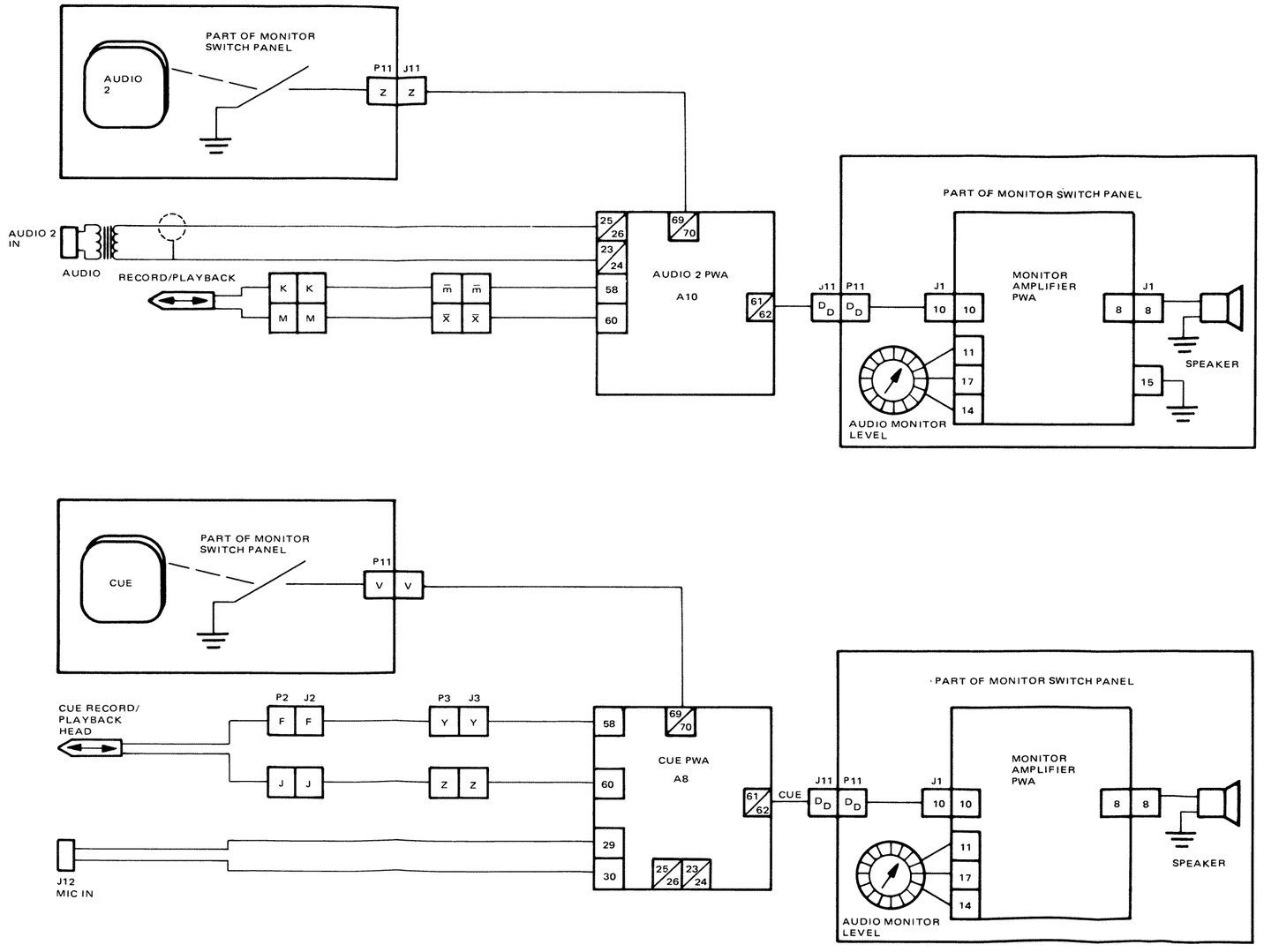

Figure 3-1. Typical Monitor Signals (Sheet 5 of 7)




NOTE: SOURCE OF THE MONITORED AUDIO DEPENDS UPON SYSTEM MODE AND POSITION OF NORMAL-MONITOR SWITCH ON THE FRONT OF THE AUDIO 1 PWA AS TABULATED BELOW.

| NORMAL-MONITOR SWITCH | SYSTEM MODE | SOURCE OF MONITORED AUDIO |
|---|---|---|
| NORMAL | RECORD | AUDIO 1 INPUT (E-E SIGNAL) |
| | STOP | AUDIO 1 INPUT (E-E SIGNAL) |
| | PLAYBACK | AUDIO 1 TRACK PLAYBACK HEAD |
| MONITOR | RECORD | OFF-TAPE SIGNAL DETECTED BY MONITOR HEAD. |
| | FAST FORWARD | OFF-TAPE SIGNAL DETECTED BY MONITOR HEAD. |
| | REWIND | PRE-MUTE MUST BE SELECTED ON MONITOR CONTROL PANEL. |
| | PLAYBACK | OFF-TAPE SIGNAL FROM PLAYBACK HEAD. |

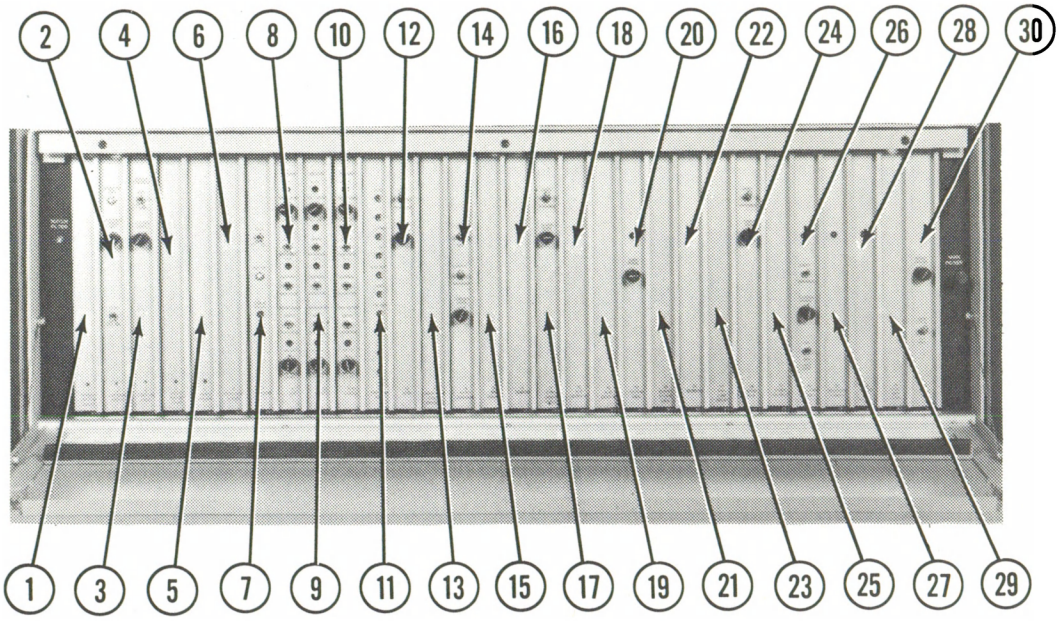
**Figure 3-1. Typical Monitor Signals (Sheet 6 of 7)**




NOTE:
1. DUAL TRACK AUDIO SYSTEM IS OPTIONAL.
2. SOURCE OF THE MONITORED AUDIO DEPENDS UPON SYSTEM MODE AND POSITION OF NORMAL-MONITOR SWITCH ON THE FRONT OF THE AUDIO 2 PWA AS SHOWN BELOW.

| NORMAL-MONITOR SWITCH | SYSTEM MODE | SOURCE OF MONITORED AUDIO |
|---|---|---|
| NORMAL | RECORD | AUDIO 2 INPUT (E-E SIGNAL) |
| | STOP | AUDIO 2 INPUT (E-E SIGNAL) |
| | PLAYBACK | AUDIO 2 TRACK PLAYBACK HEAD |
| MONITOR | MONITOR HEAD IS NOT SPLIT: IN RECORD MODE, WHEN NORMAL-MONITOR SWITCH ON AUDIO 1 PWA IS SET TO MONITOR, HEAD MONITORS BOTH TRACKS OF DUAL TRACK SYSTEM. SETTING AUDIO 2 PWA NORMAL-MONITOR SWITCH TO MONITOR WILL HAVE NO EFFECT TO STOP AURAL MONITORING OF THE AUDIO 2 INPUT (E-E) SIGNAL WHEN THE SYSTEM IS IN THE RECORD MODE. | |

Figure 3-1. Typical Monitor Signals (Sheet 7 of 7)




13094-86

1. TRACKING AND CAPSTAN DRIVE PWA (Standard) AUTO TRACKING PWA (Accessory)
2. CAPSTAN SERVO PWA
3. CT AND SYNC PROC PWA
4. HEAD PHASE COMP PWA
5. HEAD DRIVER PWA
6. CONTROL LOGIC PWA
7. EDITOR PWA (Accessory)*
8. CUE PWA
9. AUDIO I PWA
10. AUDIO II PWA (Dual/Stereo Option)*
11. POWER SUPPLY REGULATOR PWA
12. MODULATOR PWA
13. MONITOR SWITCH AND COLOR FRAMING PWA
14. BURST DETECTOR (Standard) AUTO CHROMA PWA (Accessory)
15. SW EQUALIZER PWA
16. DEMODULATOR PWA
17. VIDEO INPUT PWA
18. A/D CONVERTER A PWA
19. A/D CONVERTER B PWA
20. CLOCK GENERATOR PWA
21. BURST STORE GENERATOR PWA
22. MEMORY PWA
23. DATA BYPASS PWA (Standard) TWO-LINE DELAY PWA (Accessory)
24. MAIN D/A PWA
25. VIDEO OUTPUT PWA
26. VELOCITY COMPENSATOR I PWA (Accessory)*
27. VELOCITY COMPENSATOR II PWA (Accessory)*
28. LOGIC PWA
29. VACANT
30. SYNC GENERATOR PWA

*Position vacant if option or accessory not used

**Figure 3-2. Electronics Assembly, PWA Location**

**Table 3-2. Jumpers (Continued)**

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 2 Capstan Servo PWA 1373150 (Continued) | J5 | A - B | NORMAL – capstan error. |
| | | Removed | Removes capstan error signal from the servo loop. |
| | J6 | A - B | NORMAL – standby bias reference. |
| | | Removed | Removes standby bias reference from the servo loop. |
| | J7 | A - B | NORMAL – external capstan speed control. |
| | | Removed | Inhibits external capstan control. |
| | J8 | A - B | NORMAL |
| | | B - C | Forces CT frame pulse reference. |
| | | Removed | Forces demod frame pulse reference. |
| 3 Control Track & Sync Processor PWA 1373168 | | | No jumpers. |
| 4 Head Phase Comparator PWA 1373171 | J1 | A - B | NORMAL – vertical lock only if non-standard tape. |
| | | A - C | Always vertical locked in sequence 4. |
| | | Removed | Remains in tach lock. |
| | J2 | A - B | NORMAL – selects input sync in record. |
| | | A - C | Forces selection of reference sync in record. |
| | J3 | A - C | NORMAL – selects horizontal lock in edit only. |
| | | A - B | Will go to horizontal lock in play. |
| | | Removed | Will not horizontal lock in any mode. |
| | J4 | A - B | NORMAL – inhibits horizontal lock in any edit test mode. |
| | | A - C | Inhibits horizontal lock in any mode. |
| | | Removed | Enables horizontal lock in edit test mode. |
| 5 Head Driver PWA 1373016 | J1 | B - C | NORMAL – stops autophasing counter at terminal count. |
| | | A - B | Disables down count. |
| | | Removed | Allows counter to recycle. |
| | J2 | A - B | NORMAL – stops autophasing counter at terminal count. |
| | | B - C | Disables upcount. |
| | | Removed | Allows counter to recycle. |
| | J3 | A - B | NORMAL – autophasing counter wake-up. |
| | | B - C | Presets counter to mid-range. |
| | J4 | A - B | NORMAL – autophasing counter freeze. |
| | | B - C | Freezes counter to last known count. |
| | J5 | A - B | NORMAL – controls autophasing up/down count. |
| | | B - C | Count down only. |
| | J6 | A - B | NORMAL – autophasing enable. |
| | | Removed | Allows autophasing at all times even if servos are not locked. |
| | J7 | A - B | NORMAL – autophasing servo error. |
| | | Removed | Removes auto phasing from servo loop. |
| | J8 | A - B | NORMAL – head phase comparator error. |
| | | Removed | Removes phase comparator from the servo loop. |

Table 3-2. Jumpers (Continued)

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 5 Head Driver PWA 1373016 (Continued) | J9 | B - C | NORMAL – head frequency discriminator error. |
| | | A - B | Runs headwheel at nominal speed (open loop). |
| | | Removed | Removes discriminator from servo loop. |
| 6 Control Logic PWA 1373269 | J1 | A - B | NORMAL – video E-E/tape command correcponds to E-E/tape switch position. |
| | | A - C | Holds video command in the E-E mode until the video headwheel comes up to speed, then switches to tape. |
| | J2 | A - B | NORMAL |
| | | A - C | Constant boost command to the triac control. |
| 7 Editor (Optional) PWA 1373127 | | | No jumpers. |
| 8 Cue PWA 1374928 | J1 | A - B | Zero attenuation of input signal. |
| | | A - C | NORMAL – provides 20 dB attenuation of input signal. |
| | | A - D | Provides 40 dB attenuation of input signal. |
| | J2 | A - C | NORMAL – switches between play and shuttle equalization. |
| | | A - B | Test – forces play equalization. |
| | | | **NOTE**<br>**Jumper J3 position must be selected to coincide with position of jumper J12.** |
| | J3 | A - B | NAB – provides 2000$\mu$s (NAB standard) low frequency record preemphasis. |
| | | A - C | CCIR – no low frequency preemphasis. |
| | J4 | A - B | Bias and head switching relay always on. Used for monitoring bias and record current. |
| | | A - C | NORMAL – relay and bias energized during record only. |
| | J5 | A - B | NORMAL |
| | | B - C | Test – tape mode disabled. |
| | J6 | A - B | NORMAL – permits erase circuit to be activated. |
| | | A - C | Inhibits erase circuit. |
| | J7 | A - B | Normal operating position. |
| | | A - C | Permits monitoring erase current (always in erase mode). |
| | J8 | A - B | Muting occurs for 100 ms during switching period and in all modes except play mode. |
| | | A - C | NORMAL – muting occurs for 100 ms during switching period and in all modes except play mode and record mode. |
| | J9 | A - B | NORMAL – 240/250-Hz trap is connected to the line driver circuit. |
| | | A - C | 240/250-Hz trap is disconnected from line driver circuit. |
| | | | **NOTE**<br>**When jumper J10 is changed from one position to another, meter must be recalibrated.** |

Table 3-2. Jumpers (Continued)

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 8 Cue PWA 1374928 (Continued) | J10 | A - B | Meter monitors output signal prior to muting, meter indicates even in muted modes. |
| | | A - C | NORMAL – monitors output line signal after muting. |
| | J11 | A - B | Output impedance is 600 ohms and output level is attenuated by 10 dB. This position is used for driving long 600 ohm lines such as telephone lines. |
| | | A - C | NORMAL – output impedance is approximately 10 ohms. |
| | J12 | A - B | NAB – 2000μs (NAB standard) low frequency reproduce deemphasis. |
| | | A - C | CCIR – no low frequency reproduce deemphasis (CCIR). |
| | J13 | D - A | No muting at any time. |
| | | D - B | NORMAL – 100% muting (no signal passes) during muting periods. |
| | | D - C | 20 dB attenuation during muting periods. |
| 9/10 Audio PWA 1373478 | J1 | A - B | Zero attenuation of input signal. |
| | | A - C | NORMAL – provides 20 dB attenuation of input signal. |
| | | A - D | Provides 40 dB attenuation of input signal. |
| | | | **NOTE**<br>**Jumper J3 position must be selected to coincide with position of jumper J12.** |
| | J3 see J-12 | A - B | Provides 2000μs (NAB standard) low frequency record preemphasis. |
| | | A - C | Provides no low frequency preemphasis (CCIR standard). |
| | J4 | A - B | Test – bias and head switching relays always on. Used for monitoring bias and record current. |
| | | A - C | NORMAL – relay and bias energized during record only. |
| | J5 | A - B | NORMAL |
| | | A - C | Test – tape mode disabled. |
| | J6 | A - B | NORMAL – enables erase circuit to be activated. |
| | | A - C | Inhibits erase circuit. |
| | J7 | A - B | NORMAL |
| | | A - C | **Enables erase circuit for test setup.** |
| | J8 | A - B | Muting occurs for 100 ms during switching period and in all modes except play mode. |
| | | A - C | NORMAL – Muting occurs for 100 ms during switching period and in all modes except play and record mode. |
| | J10 | A - B | Meter monitors output signal prior to muting; meter indicates even in muted modes. |
| | | | **NOTE**<br>**When jumper J10 is changed from one position to another, meter must be recalibrated by adjusting R159.** |

Table 3-2. Jumpers (Continued)

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 9/10 Audio PWA 1373478 (Continued) | J10 (Cont'd.) | A - C | NORMAL – monitors output line signal after muting. |
| | J11 | A - B | Output impedance is 600 ohms and output level is attenuated by 10 dB. This position is used for driving long 600 ohm lines such as telephone lines. |
| | | A - C | NORMAL – output impedance is approximately 10 ohms. |
| | | | **NOTE**<br>**Jumper J12 position must be selected to coincide with position of jumper J3.** |
| | J12 | A - B | NORMAL – 2000μs (NAB standard) low frequency reproduce deemphasis. |
| | | A - C | CCIR – no low frequency reproduce deemphasis (CCIR standard). |
| | J13 | D - A | No muting at any time. |
| | | D - B | NORMAL – 100% muting (no signal passes) during muting periods. |
| | | D - C | 20 dB attenuation during muting periods. |
| | | | **NOTE**<br>**Jumper J14 must be used in conjunction with jumper J15.** |
| | J14 | A - C | NORMAL – 7-1/2 ips record equalization. |
| | | A - B | Super equalization, record preemphasis at 7-1/2 ips, 4 dB higher than normal. |
| | | | **NOTE**<br>**Use jumper J15 A - B position only with high oerstead tapes.** |
| | J15 | A - C | NORMAL |
| | | A - B | Super 7-1/2 ips deemphasis, 4 dB lower than normal. |
| | J16 | A - B | MONO audio. or stereo |
| | | A - C | DUAL audio. |
| 11 Power Supply Regulator PWA 1373120 | | | No jumpers. |
| 12 Modulator PWA 1373147 | J1 | NORM | NORMAL |
| | | TEST | Test – clamps video to ground |
| | J2 | NORM | NORMAL |
| | | TEST | Test – deactivates preemphasis. |

Table 3-2. Jumpers (Continued)

| | MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|---|
| 12 | Modulator PWA 1373147 (Continued) | J3 | A - B<br>Removed | NORMAL<br>Test – when removed, opens AFC feedback to modulator circuit. |
| 13 | Monitor Switch & Framing Detector PWA 1373153 | J1 | A - B | Video goes to black in E-E, video does not go to black in tape. |
| | | J2 | A - B | Inhibits video from black in record. |
| | | J3 | A - B | Video goes to black if rf is missing. |
| | | J4 | A - B | Video goes to black if there is no servo lock. |
| | | J5 | A - B | Video is inhibited from black when editor is on. |
| | | J6 | A - B | Routes input video to the sync generator (PWA 30) for locking purposes when in E-E. |
| | | J7 | A - B | Routes input video to the sync generator during record. |
| | | J8 | A - B | Routes input video to the sync generator during the editor process. |
| | | J9 | A - B<br>A - C | 525-line standard (NTSC)<br>625-line standard (PAL/SECAM, PAL-M).<br>**NOTE**<br>**For PAL-M standard place jumper J9 in A - C position. Modification to PWA required.** |
| | | J10 | A - B<br>B - C | NORMAL<br>Test position. |
| 14 | Burst Detector PWA 1375386 | | | No jumpers. |
| 14 | Auto-Chroma (optional) PWA 1373165 | J1 | A - B<br>– | NORMAL<br>When removed, permits remote chroma level adjustments. |
| | | J2 | A - B<br>A - C | 3.58-MHz filter select (NTSC).<br>4.43-MHz filter select (PAL/SECAM). |
| 15 | Switcher & Equalizer PWA 1373055 | J1 | A - B<br>B - C | NORMAL – connects signal through to the equalizer.<br>Test – connects TEST INPUT to equalizer for equalizer setup. |
| | | J3 | A - B<br>– | NORMAL – connects signal to master equalizer.<br>Test – removed for equalizer setup. |
| | | J4 | A - B<br>A - C<br>B - C | NORMAL – connects signal to low-pass filter.<br>Test – for equalizer setup.<br>Test – for low-pass filter setup. |
| | | J6 | –<br>A - B | NORMAL – jumper removed.<br>Test – bypasses the differential gain adjustment network. |
| | | J7 | Removed<br>A - B | NORMAL – jumper removed.<br>Test – for equalizer setup. |

Table 3-2. Jumpers (Continued)

| | MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|---|
| 16 | Demodulator PWA 1373058 | J1 | A - C<br>A - B | NORMAL – connects signal to low-pass filter driver.<br>Test – for low-pass filter setup. |
| | | J3 | A - C<br>A - B | NORMAL – connects signal to low-pass filter driver.<br>Test – for low-pass filter setup. |
| | | J4 | A - B<br>A - C | NORMAL – passes signal from the low-pass filter to the equalizer.<br>Test – for filter setup. |
| | | J5 | A - B<br>Removed | NORMAL – connects video feedback clamp.<br>Test – for low-pass filter setup. |
| | | J6 | A - B<br>Removed | NORMAL – connects video feedback clamp.<br>Test – for low-pass filter setup. |
| | | J7 | Removed<br>400μF<br>A - B | NORMAL – jumper removed<br>Capacitor connected from A to B is an ac bypass of the deemphasis network for the low-pass filter setup. |
| 17 | Video Input PWA 1374010 | J1 | A - B<br>B - C | NORMAL<br>Sawtooth test signal on. |
| | | J2 | A - B<br>B - C | NORMAL<br>Factory test (set up for dropout window one-shot). |
| | | J3 | A - B<br>B - C<br>Removed | NORMAL – TBC color/monochrome operation.<br>Forces the TBC in monochrome operation.<br>When removed, forces color operation. |
| | | J4 | A - B<br><br><br>Removed | NORMAL – if VTR dropout pulse is supplied to TBC, video is switched to black during dropout. (Note: Black video is present only if J5 is in B - C position.)<br>Remove jumper to prevent video from switching to black during dropout. |
| | | J5 | A - B<br>B - C | NORMAL – dropout compensator enabled.<br>Dropout compensator inhibited. |
| | | J6 | A - B<br>B - C | NORMAL (local black level control).<br>Factory test (remote black level control). |
| 18 | A/D Converter A PWA 1374254 | J1 | A - B<br>B - C | NORMAL<br>Factory test – grounds input to four most significant bit slicers. |
| 19 | A/D Converter B | J1 | A - B<br>B - C | NORMAL<br>Factory test – grounds input to four least significant bit slicers. |
| 20 | Clock Generator PWA 1374026 | J1 | A - B<br>B - C | NORMAL – local control subcarrier phase.<br>Remote control subcarrier phase. |
| | | J2 | A - B<br>B - C | NORMAL<br>Factory test (set up of reference 3.58-MHz circuits). |

Table 3-2. Jumpers (Continued)

| MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|
| 20 Clock Generator PWA 1374026 (Continued) | J3 | A - B<br>B - C | NORMAL<br>Factory test (forces reference 10.7-MHz clock instead of switched 10.7-MHz clock). |
| | J4 | Removed<br>A - B | NORMAL – jumper removed<br>Factory test (set up of reference 10.7-MHz filter). |
| | J5 | Removed<br>A - B | NORMAL – jumper removed.<br>Factory test (set up of tape 10.7-MHz filter). |
| | J6 | A - C<br>A - B | NORMAL<br>Factory test (set up of tape 3.58-MHz filter). |
| | J7 | A - B<br>or B - C | Position of jumper determined during factory test (establishes chroma phase range). |
| 21 Burst Store Generator PWA 1402800 | J1 | B - C<br>A - B | NORMAL<br>Factory test (used with J2 to bypass burst store memory). |
| | J2 | A - B<br>B - C | NORMAL<br>Factory test (used with J1 to bypass burst store memory). |
| | J3 | A - B<br>Removed | NORMAL<br>Removed for factory test (set up of D/A converter). |
| | J4 | Removed<br>B - A<br>B - C | NORMAL – jumper removed.<br>Factory test.<br>Future use. |
| 22 256-Word Memory PWA 1374050 | | | No jumpers. |
| 23 Data Bypass PWA 1374109 | | | No jumpers. |
| 23 Two Line Delay (optional) PWA 1374058 | J1 | A - B<br>Removed | NORMAL<br>Remove for factory test (prevents program counter no. 1 from being reset). |
| | J2 | A - B<br>Removed | NORMAL<br>Remove for factory test (allows program counter no. 1 to count continuously). |
| | J3 | A - B<br>Removed | NORMAL<br>Remove for factory test (allows program counter no. 2 to count continuously). |
| 24 Main D/A PWA 1374066 | J1 | A - B<br>A - C | NORMAL – with velocity compensator.<br>NORMAL – without velocity compensator. |
| | J2 | A - B<br>A - C | NORMAL – with velocity compensator.<br>NORMAL – without velocity compensator. |
| 25 Video Output PWA 1374070 | J1 | A - B<br>Removed | NORMAL<br>Removed for factory test (removes amplitude equalizer RC networks). |

Table 3-2. Jumpers (Continued)

| | MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|---|
| 25 | Video Output PWA 1374070 (Continued) | J2 | A - B | NORMAL |
| | | | Removed | Removed for factory test (disconnects dc level shift reference). |
| | | J3 | A - C | NORMAL – composite video at VIDEO OUT 2. |
| | | | B - C | Non-composite video at VIDEO OUT 2. |
| 26 | Velocity Compensator No. 1 (optional) PWA 1374244 | J1 | A - B or B - C | Position of jumper determined during factory test in order to minimize phase error. |
| 27 | Velocity Compensator No. 2 (optional) PWA 1374082 | J1 | A - B | NORMAL |
| | | | B - C | Factory test (puts burst-hold error at OV to phase shifter). |
| | | J2 | A - B | NORMAL |
| | | | Removed | Removed for factory test (opens phase loop in velocity error detector). |
| 28 | Logic PWA 1374278 | J1 | Removed | NORMAL – jumper removed. |
| | | | A - B | Factory test (disables recentering circuit). |
| | | J2 | Removed | NORMAL – jumper removed. |
| | | | A - B | Factory test (disables horizontal correction circuit). |
| | | J3 | Removed | NORMAL – jumper removed. |
| | | | | **NOTE**<br>**Jumpers J4 and J5 must be removed for the following J3 test positions.** |
| | | | B - C | Memory function test – 1/4 sec. |
| | | | B - D | Memory function test – 1/2 sec. |
| | | | B - A | Memory function test – 1 sec. |
| | | J4 | A - B | NORMAL |
| | | | Removed | Removed for memory function test (refer to J3). |
| | | J5 | A - B | NORMAL |
| | | | Removed | Removed for memory function test (refer to J3). |
| 30 | Sync Generator PWA 1373083 | J1 | B - C | AUTO SEL – used only if the stable oscillator accessory is installed. Uses stable oscillator when S1 on Internal Reference or there is no video input. |
| | | | A - B | EXT REF – when stable oscillator accessory not installed. Oscillator used depends on position of J2. |
| | | J2 | A - B | NORMAL – crystal-controlled (XTAL VCO). |
| | | | B - C | Wide-range sync-lock function (LC VCO). |
| | | J3 | Removed | NORMAL – jumper removed. |
| | | | A - B | Unblank line 17 of field 1. |

Table 3-2. Jumpers (Continued)

| | MODULE | JUMPER | POSITION | REMARKS |
|---|---|---|---|---|
| 30 | Sync Generator PWA 1373083 (Continued) | J4 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 18 of field 1. |
| | | J5 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 19 of field 1. |
| | | J6 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 20 of field 1. |
| | | J7 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 21 of field 1. |
| | | J8 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 17 of field 2. |
| | | J9 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 18 of field 2. |
| | | J10 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 19 of field 2. |
| | | J11 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 20 of field 2. |
| | | J12 | Removed<br>A - B | NORMAL – jumper removed.<br>Unblank line 21 of field 2. |
| | | J13 | A - B<br>B - C | NORMAL<br>Inhibits sync-delay control. |

## SYSTEM POWER

Main power is connected to the system through a captive power cable that is attached to circuit breaker CB1 in the power supply. The main power transformer (see Figures 3-3 and 3-4) has various taps that permit the system to use any one of ten different input voltages: 105, 110, 115, 120, 127, 210, 220, 230, 240, and 254 Vac. Line voltage at the power transformer should be measured under load conditions and, if required, the taps set to correspond to the line voltage. Table 3-3 lists the tap connections on the transformer and the circuit breaker for the various input voltages.

Circuit breaker CB1 actually comprises two separate circuit breakers – a 7.5-amp circuit breaker and a 15-amp circuit breaker. Only one circuit breaker is used, depending on the voltage of the power source supplying the system. If the power source voltage is 115 Vac (nominal), the 15A circuit breaker is used. The 7.5A circuit breaker is used when the system is supplied by 220Vac (nominal) power. Note that a terminal of the unused circuit breaker (terminal 1A) on the 15A circuit breaker or terminal 2A on the 7.5A circuit breaker is used as a tie point for the AC COM (white) lead.

### CAUTION

**WHEN MODIFYING THE SYSTEM FROM 220-VAC TO 115-VAC OPERATION OR FROM 115-VAC TO 220-VAC OPERATION, THE AC COM LEAD (WHITE) MUST BE RECONNECTED TO THE SPARE TERMINAL ON THE UNUSED CIRCUIT BREAKER. THE SPARE TERMINAL PROVIDES A CONVENIENT TIE LUG.**

The rear panel of the electronics assembly is hinged at the bottom and can be folded down for access to power supply components. The system power supply (see Figure 3-5) consists of a dc

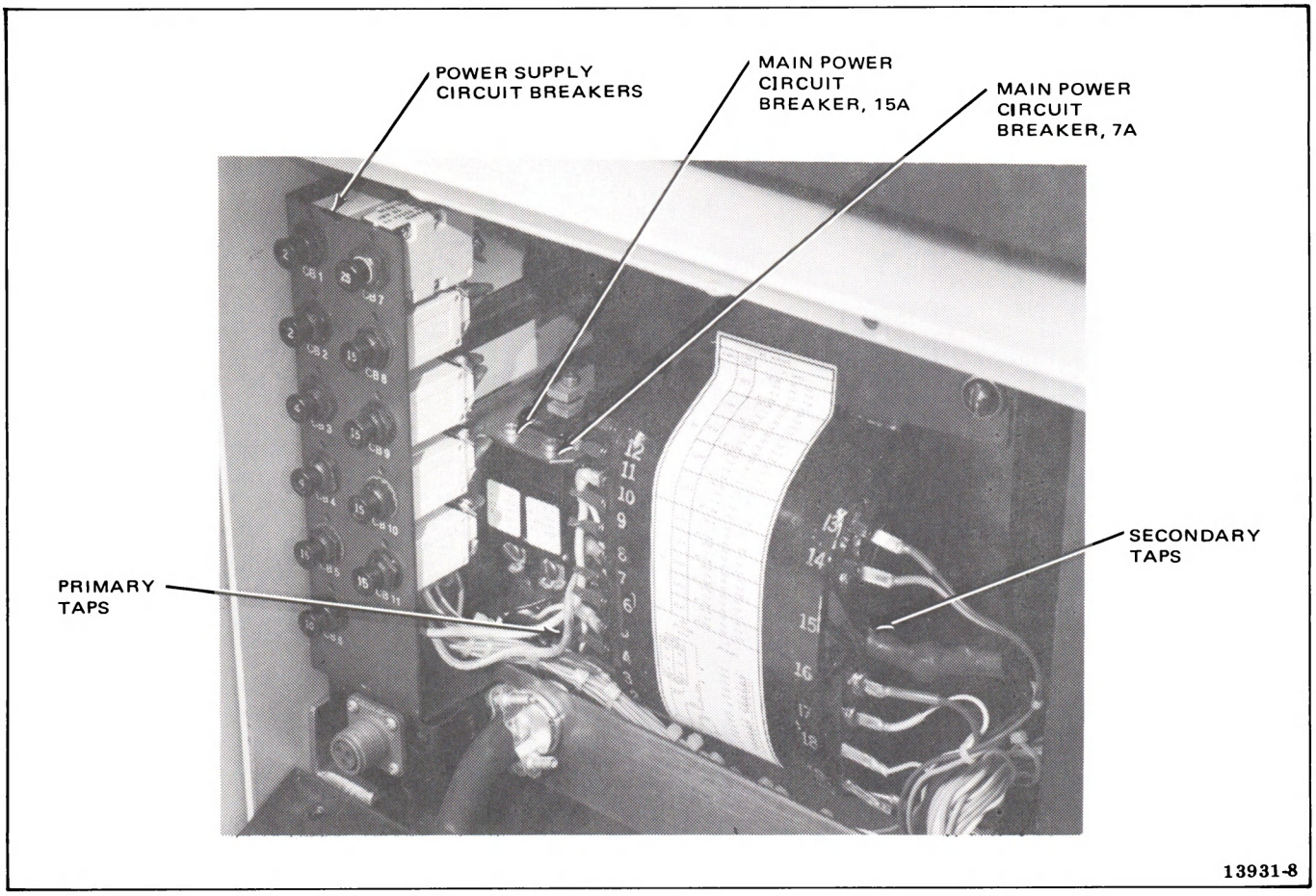



**Figure 3-3. Power Transformer Tap Connections**

voltage source and various regulators. The dc source comprises an iron-core transformer, diode bridge full-wave rectifiers, and filter capacitors. The dc source is mounted in a removable tray at the rear of the electronics card rack. The tray is secured to the chassis with two screws, and the dc source is connected to the regulators through an extra long cable that allows the tray to be removed for maintenance without disconnecting any of the wiring.

The regulators are contained on two PWAs. The servo and relay power supply regulator PWA is mounted on the inside of the electronics assembly rear panel. The other regulator PWA, the power supply regulator PWA, is a plug-in assembly mounted in slot number 11 of the electronics assembly card rack. Series-element power transistors and 25-watt series resistors associated with the servo and relay power supply regulator PWA are mounted on the heatsinks next to it on the electronics assembly rear panel. The power regulator PWA mounted in slot 11 of the card rack controls power transistors mounted on heatsinks on the vertical panel behind the electronics assembly card rack.

With the dc power source tray removed, all of the power transistors are accessible for testing if required. An ac input 15-ampere (7.5 ampere in 210-volt systems) circuit breaker (CB1) is mounted to the left of the power transformer on the power source tray. Main ac power is supplied to the electronics assembly through this circuit breaker. A pushrod is secured to the breaker switch with a clevis and bolt attachment. The pushrod enables breaker switching from the front of the electronics assembly.

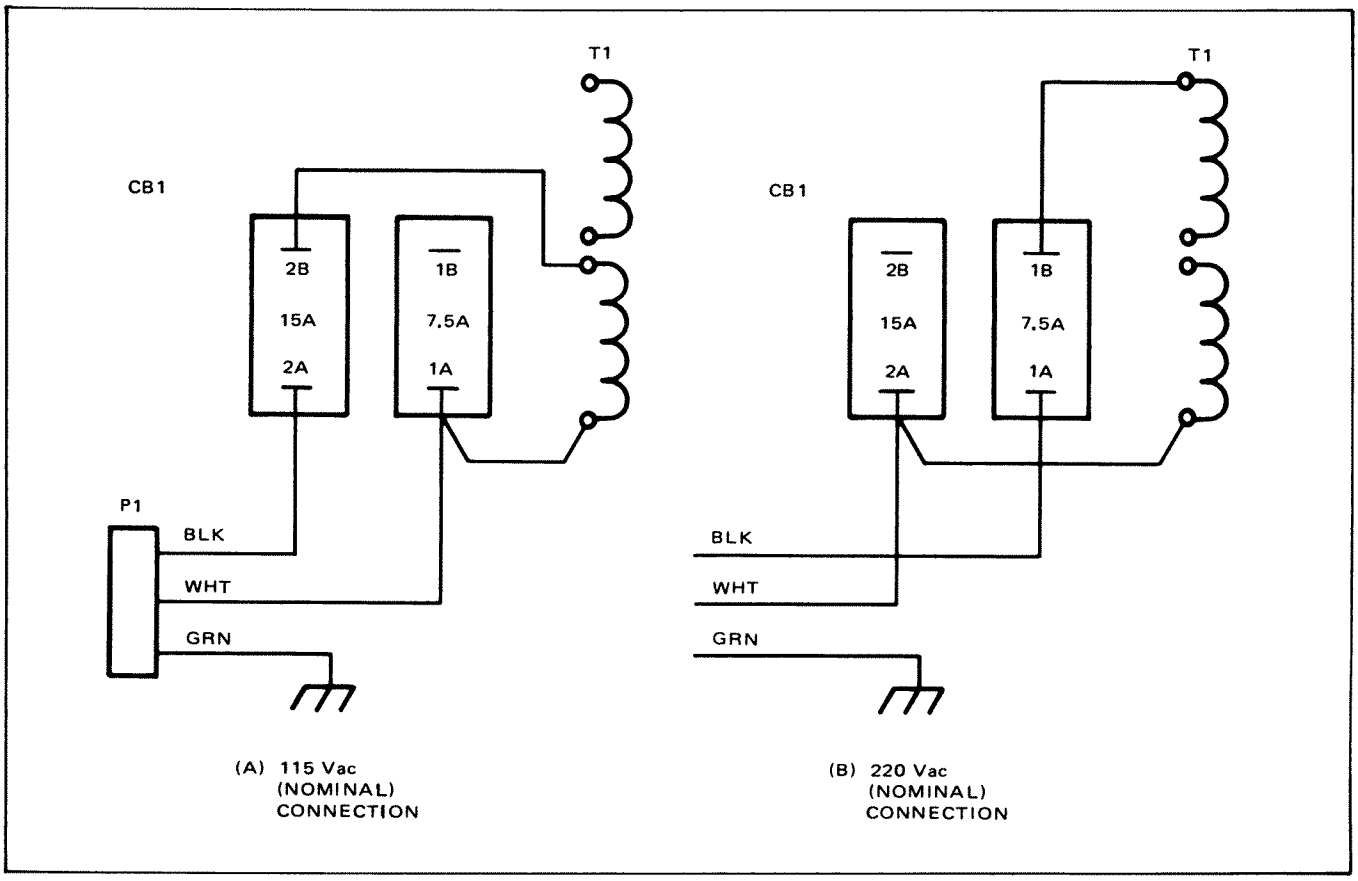



**Figure 3-4. Circuit Breaker CB1 Connections**

**Table 3-3. Main Power Transformer Primary Taps**

| PRIMARY CURRENT | PRIMARY VOLTAGE | CONNECTIONS | |
|---|---|---|---|
| | | FROM | TO |
| 15 AMPS | 105 Vac | CB1-2B | T1-1 |
| | | T1-1 | T1-7 |
| | | T1-2 | T1-8 |
| | | AC COM | T1-2 |
| | 110 Vac | CB1-2B | T1-1 |
| | | T1-1 | T1-7 |
| | | T1-3 | T1-9 |
| | | AC COM | T1-3 |
| | 115 Vac | CB1-2B | T1-1 |
| | | T1-1 | T1-7 |
| | | T1-4 | T1-10 |
| | | AC COM | T1-4 |

Table 3-3. Main Power Transformer Primary Taps (Continued)

| PRIMARY CURRENT | PRIMARY VOLTAGE | CONNECTIONS | |
|---|---|---|---|
| | | FROM | TO |
| 15 AMPS (Continued) | 120 Vac | CB1-2B<br>T1-1<br>T1-5<br>AC COM | T1-1<br>T1-7<br>T1-11<br>T1-5 |
| | 127 Vac | CB1-2B<br>T1-1<br>T 1-6<br>AC COM | T1-1<br>T1-7<br>T1-12<br>T1-6 |
| 7.5 AMPS | 210 Vac | CB1-1B<br>T1-2<br>AC COM | T1-1<br>T1-7<br>T1-8 |
| | 220 Vac | CB1-1B<br>T1-3<br>AC COM | T1-1<br>T1-7<br>T1-9 |
| | 230 Vac | CB1-1B<br>T1-4<br>AC COM | T1-1<br>T1-7<br>T1-10 |
| | 240 Vac | CB1-1B<br>T1-5<br>AC COM | T1-1<br>T1-7<br>T1-11 |
| | 254 Vac | CB1-1B<br>T1-6<br>AC COM | T1-1<br>T1-7<br>T1-12 |

A block diagram of the system power supply is given in Figure 3-6. A block diagram of the power supply regulator PWA showing its interconnection with the dc power source and the heatsink assemblies is given in Figure 3-7. A block diagram of the servo and relay power supply regulator showing its interconnection with the dc power source and the rear panel heatsinks is given in Figure 3-8.

### Power Supply Regulator Adjustment

The procedure for adjusting the power supply regulator is as follows.

NOTE

**The voltage measurements in this procedure require the use of a precision digital voltmeter, HP 3462A or equivalent. Proper operation of the system is dependent upon correct adjustment of the power supply.**

1. Place power supply regulator PWA (In the number 11 slot of the electronics assembly card rack) on an extender.

2. Turn on system power.

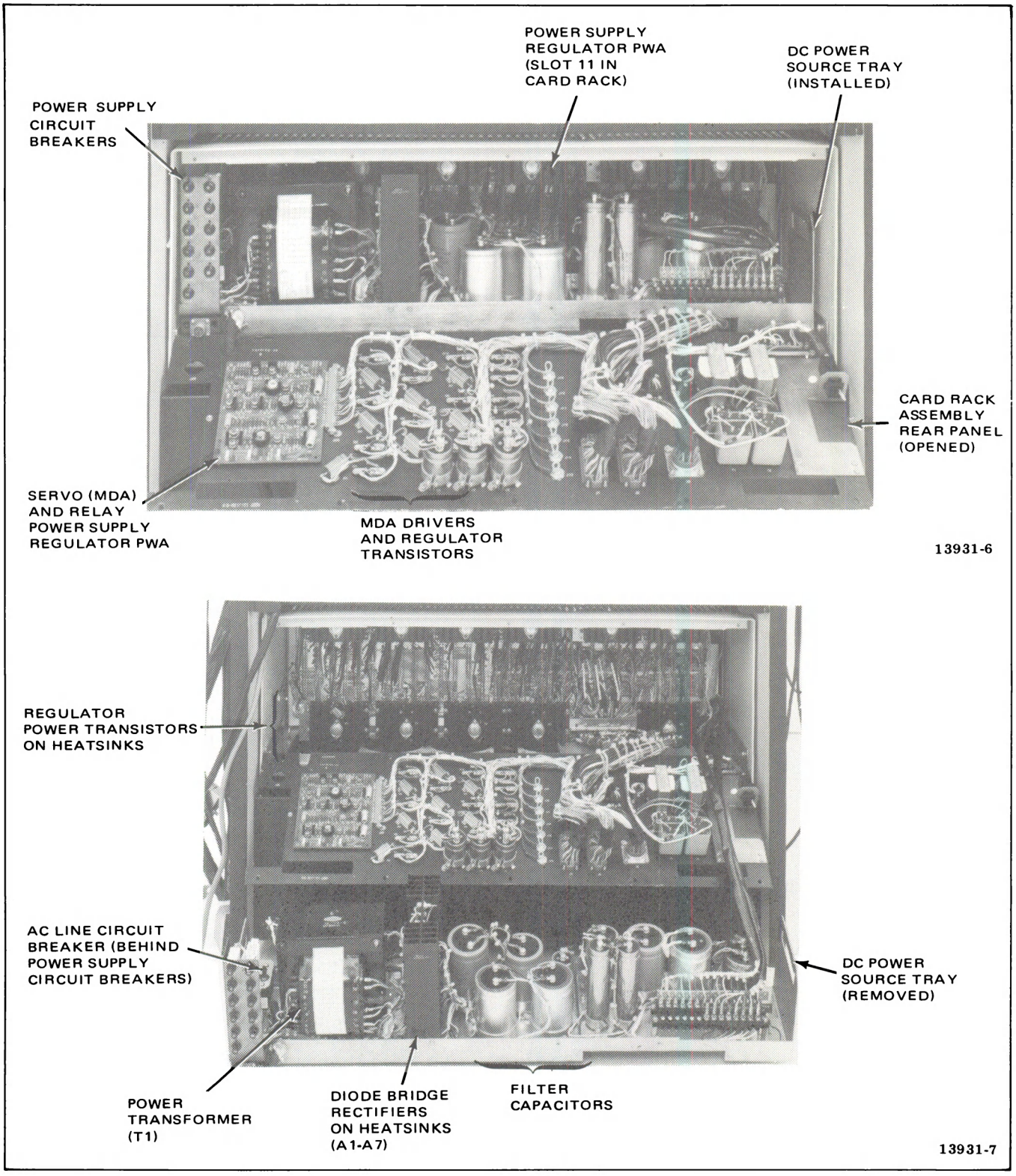



**Figure 3-5. System Power Supply**

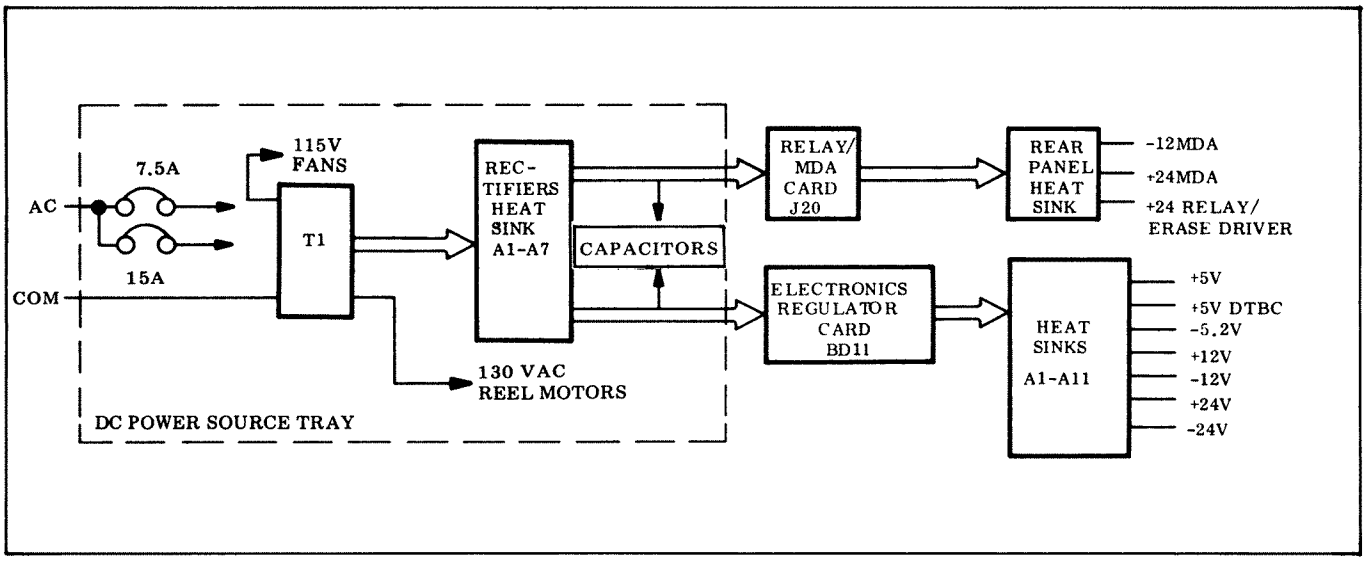



**Figure 3-6. System Power Supply Block Diagram**

3. Connect voltmeter between test points TP5 and TP6 through the front of the PWA.

4. Adjust potentiometer R96 (see Figure 3-9) if necessary for a reading of +12.000 ±0.025V.

5. Verify that the following voltages are present at the test points.

| TEST POINT | VOLTAGE |
|---|---|
| TP1 | +12.00 ±0.25V |
| TP2 | +5.0 ±0.1V |
| TP3 | +5.0 ±0.1V |
| TP4 | +24.0 ±0.5V |
| TP7 | -12.00 ±0.25V |
| TP8 | -24.0 ±0.5V |
| TP9 | -5.2 ±0.1V |
| TP10 | -12.00 ±0.25V |

6. Lower the rear panel of the electronics chassis assembly to gain access to the servo and relay power supply regulator PWA (see Figure 3-5).

7. Connect voltmeter between TP1 and ground on the servo and relay power supply regulator PWA. If necessary, adjust potentiometer R49 for +24.0 ±0.5V on the voltmeter.

8. Connect voltmeter between TP2 and ground. If necessary, adjust potentiometer R50 for +24.0 ±0.5V on the voltmeter.

9. Connect voltmeter between TP3 and ground. If necessary, adjust potentiometer R51 for -12.0 ±0.5V on the voltmeter.

## TRANSPORT ADJUSTMENTS

### Braking and Driving Tension Adjustments, Capstan Idler Pressure Adjustment

The procedures for adjusting and checking the brake tension on each of the reels are given in the following paragraphs. The procedures of these paragraphs should be performed in the order given using the following equipment.

Spring scale, 0-36 oz (Ampex 360-414)
Spring scale, 0-74 oz (Ampex 650-103)

Spring scale, 0–5 lb (Ampex 650-215)
A 4-foot length of nylon cord with a 1 to 2-inch loop at each end. A 3-foot length of 2-inch magnetic tape.

**Takeup Torque (Normal) Adjustment Procedure.** Adjust the takeup torque as follows.

NOTE

**Before making a measurement with a spring scale, hold scale parallel to floor to determine its true zero indication. Note the zero offset, if any, and include correction factor in measurement.**

1. Pull control panel (see Figure 3-10) forward for access to tape transport latch handle.
2. Release tape transport top plate by pushing down and to the right on latch handle. When released from the latch, the front of the transport top plate raises for access to the triac control box beneath.
3. Lift the transport up and back.
4. Turn on recorder's main power.
5. Place a 1/4-inch wedge between supply tension arm and supply tension arm stop.
6. Place one end of nylon cord through reel guide and hub of takeup turntable.
7. Feed one nylon cord loop through other nylon cord loop and fasten cord to reel guide. Wrap two or three turns of cord clockwise around hub and fasten free loop to hook of 0–36 spring scale.

CAUTION

HOLD THE TURNTABLE MOMENTARILY AS THE PLAY PUSHBUTTON IS PRESSED TO ELIMINATE THE STARTUP SURGE. IN EACH OF THE FOLLOWING BRAKING AND DRIVING TENSION ADJUSTMENTS, *DO NOT* PRESS STOP PUSHBUTTON WHEN REELS ARE IN MOTION; STOP MOTION BY REMOVING THE WEDGE.

8. Hold onto takeup reel hub momentarily and press PLAY pushbutton. As the cord winds onto reel hub, move scale smoothly towards the reel hub, keeping cord at tension that just balances torque. When measuring, hold scale off to the side of the tape transport parallel to the floor. Note an indication of 25±1 oz (708 ±28g). Adjust the TU (takeup) control on the triac control box, if necessary, to obtain this reading.
9. When adjustment is completed, remove wedge from between supply tension arm and stop.
10. Turn off main power.

**Takeup Torque (Boost) Measurement.** Measure the takeup boost torque as follows:

1. Apply the nylon cord to the takeup turntable as in the previous procedure.
2. Place the control logic PWA (PWA 6) on an extender and remove jumper J2 (on PWAs not having a jumper J2, connect the negative end of capacitor C28 to ground).
3. Insert a 1/4-inch wedge between the supply tension arm and the supply tension arm stop.

NOTE

**If the supply turntable starts moving when power is applied after changing jumper J12 (or grounding C28), the turntable must be held motionless until the PLAY pushbutton is pressed or an incorrect reading may be obtained.**

4. Turn on main power, press the PLAY pushbutton and measure a torque of 50 oz. ±6 oz (1417 ±170g). Measure torque at the takeup hub using nylon cord and appropriate scale in accordance with the procedure of the previous paragraph.

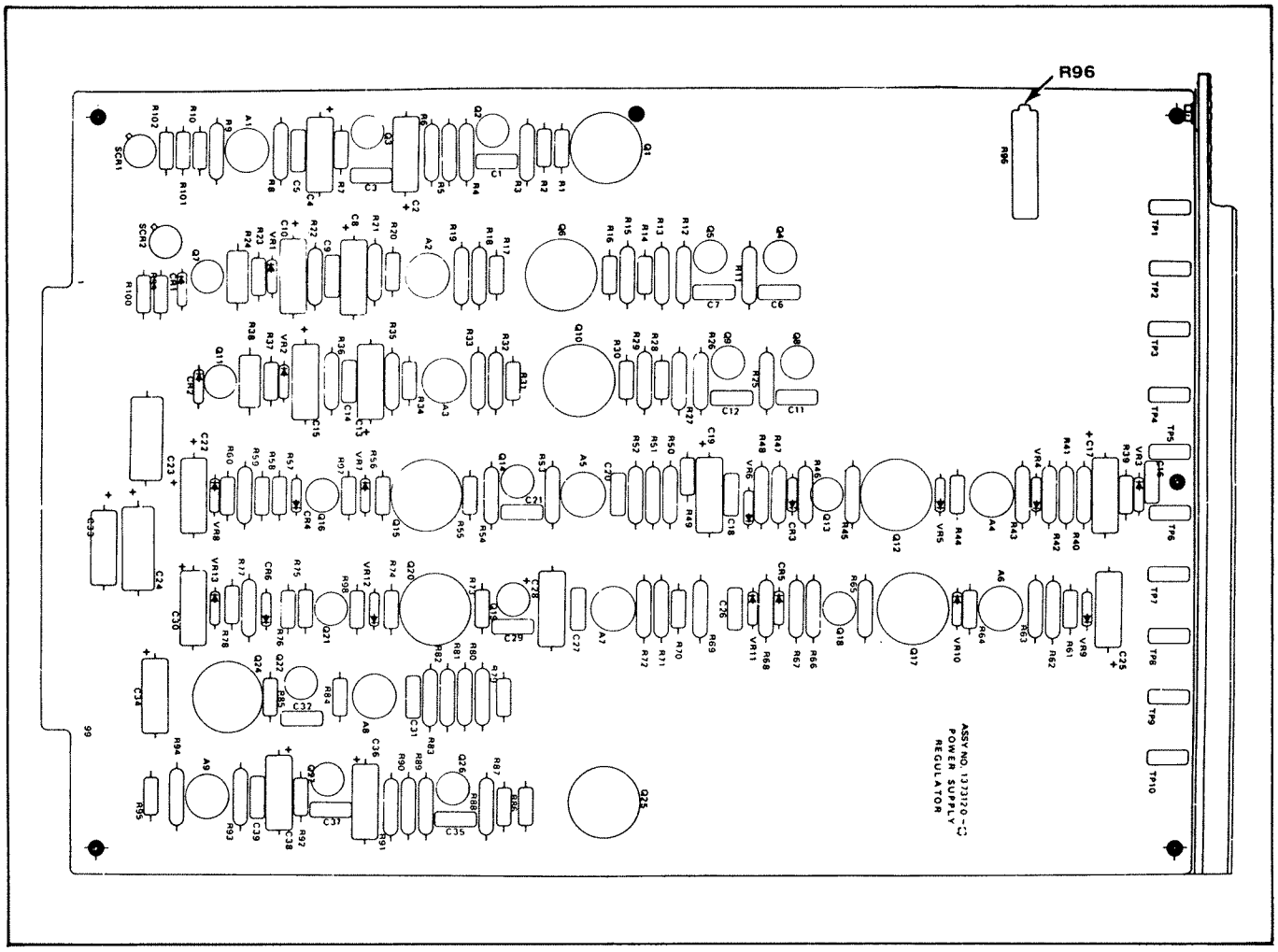



**Figure 3-9. Power Supply Regulator PWA, Module No. 11, Assembly No. 1373120**

5. Remove the wedge from the tension arm and remove jumper at C28, if one had been placed. Replace jumper J2 to the A - B position.

**Takeup Turntable Rewind Holdback Torque Measurement.** Measure the rewind holdback torque at the takeup turntable as follows:

1. Apply the nylon cord to the takeup turntable as in the previous procedures.

2. Press the REWIND pushbutton.

3. Measure a torque of 10 ±1 oz. (283 ±28g) at the takeup hub using the nylon cord and appropriate scale in accordance with the procedure of the previous paragraph.

4. Remove the wedge at the supply tension arm.

**Takeup Turntable Brake Tension Adjustment.** Adjust the takeup turntable brake tension as follows:

1. Stop the recorder.

2. Wrap the entire length of nylon cord counterclockwise around the takeup reel hub and fasten hook of the 36 oz. scale to outer cord loop.

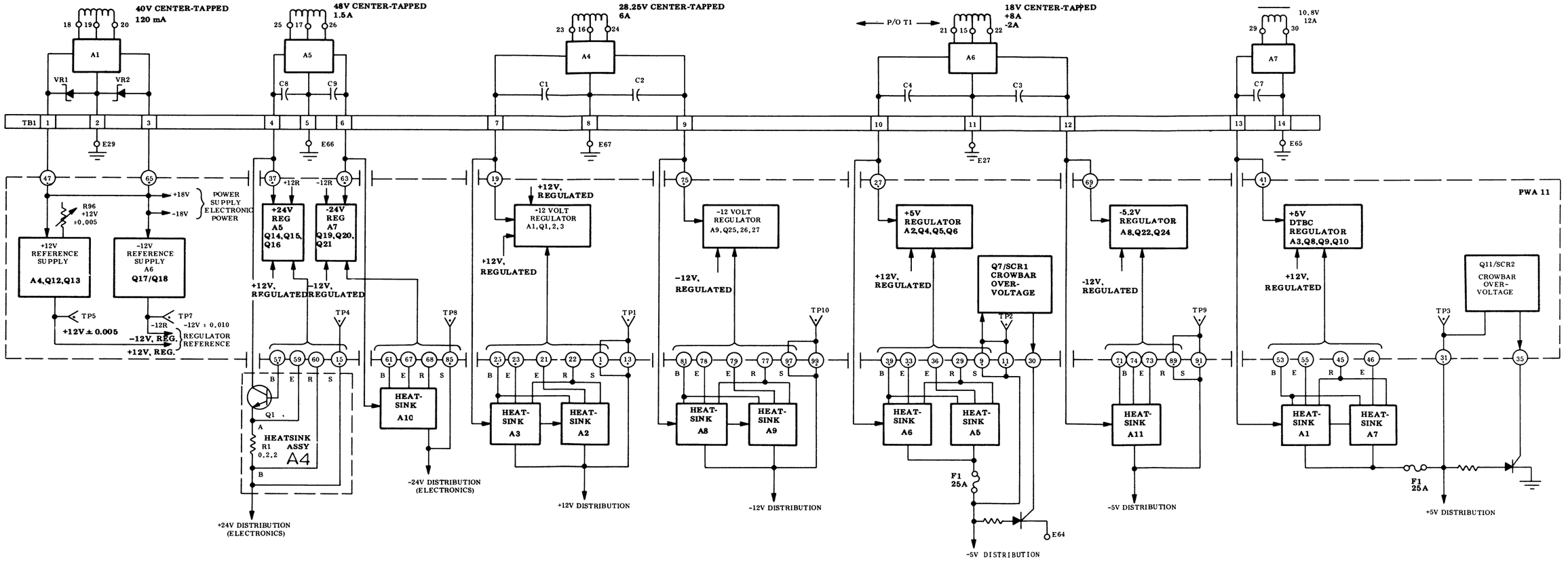



Figure 3-7. Power Supply Regulator PWA Block Diagram

| 210 VAC TO 254 VAC<br>CB1-1B TO T1-1 | | |
|---|---|---|
| | AC COMMON TO | T1-7 TO |
| 210V | T1-8 | T1-2 |
| 220V | T1-9 | T1-3 |
| 230V | T1-10 | T1-4 |
| 240V | T1-11 | T1-5 |
| 254V | T1-12 | T1-6 |

| 105VAC TO 127 VAC<br>CB1-2B TO T1-1 | | |
|---|---|---|
| | T1-1 TO AC COMMON | T1-7 TO |
| 105V | T1-2 | T1-2-8 |
| 110V | T1-3 | T1-3-9 |
| 115V | T1-4 | T1-4-10 |
| 120V | T1-5 | T1-5-11 |
| 127V | T1-6 | T1-6-12 |

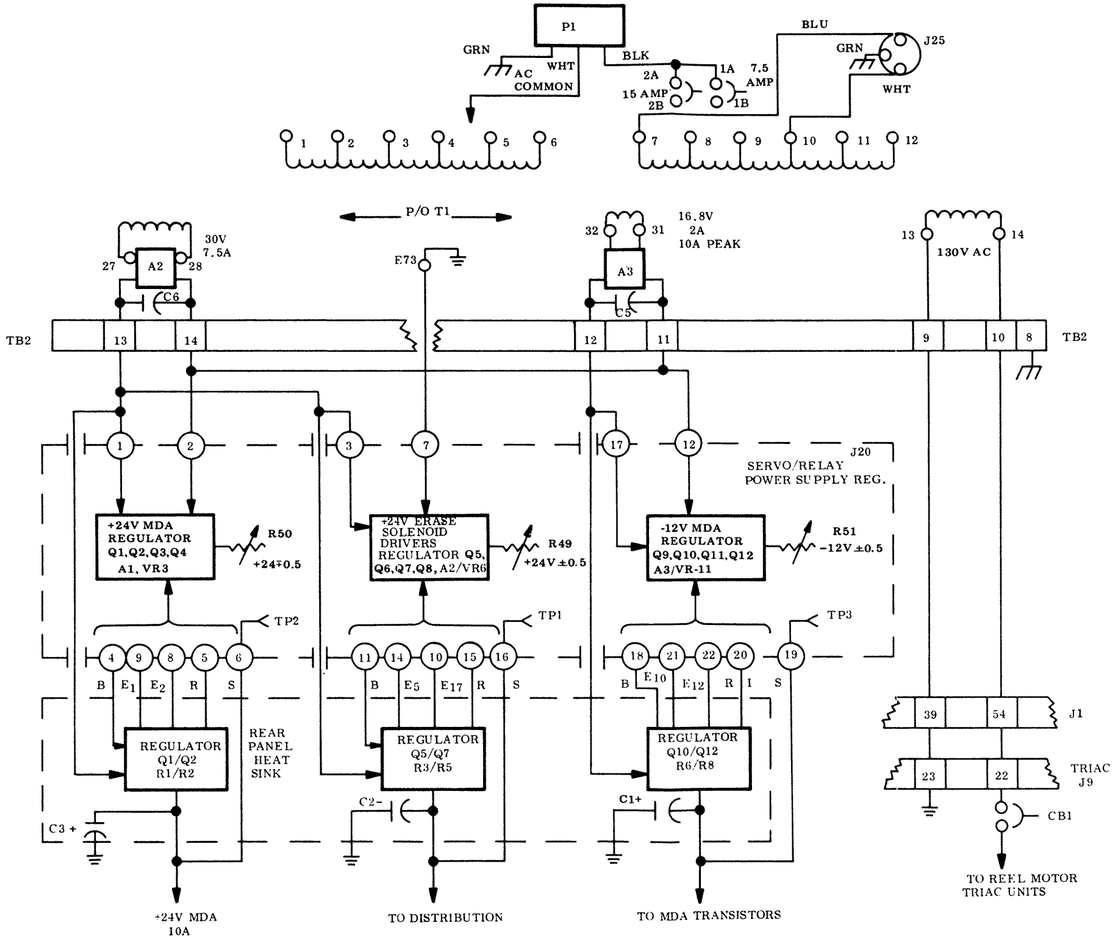



**Figure 3-8. Servo and Relay Power Supply Regulator Block Diagram**

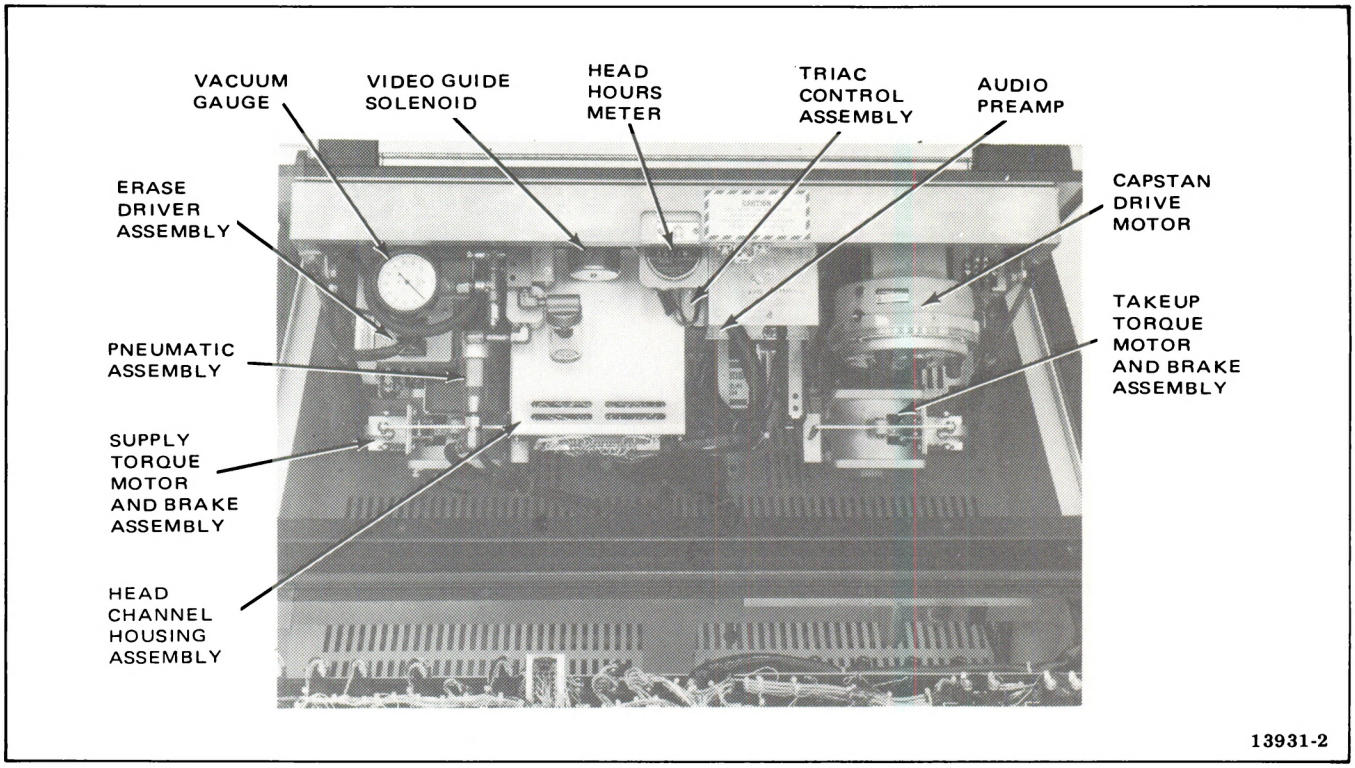



**Figure 3-10. Tape Transport Assembly, Top Plate Raised**

3. Hold scale parallel to floor close to reel hub, and pull scale to unwind cord from reel hub (the takeup turntable will rotate counterclockwise). The scale should indicate 24 ±4 oz. (680 ±113g). If necessary, adjust the nut on the takeup reel brake assembly (the nut is on the spring-loaded arm opposite the brake solenoid) to achieve this indication. Turn the nut clockwise to increase tension (see Figure 3-11).

4. Wrap the entire length of the nylon cord clockwise around the nylon hub and fasten hook of the 0–15 lb scale to cord loop.

5. Hold scale parallel to the floor as close as possible to reel hub.

6. Pull scale to unwind cord from reel hub (turntable will turn clockwise).

7. While cord is being pulled from hub at a steady rate, read scale tension.

8. Repeat step 7 until several readings of the same value have been made; the scale should indicate 7.5 lb ±8 oz. (3402 ±226g) of tension. If the indication is not within these limits, perform step 9.

NOTE

**Brake tension is increased by increasing the tension on the two springs associated with the brake solenoid. Both springs must be loaded to the same tension; if the indicated tension varies while the cord is being pulled at a steady rate, the spring tensions may be unequal.**

9. Adjust the double set of spring loaded arms (move both nuts equal distance) extending on either side of the brake solenoid to change the tension. Repeat step 8. If the tension varies while the string is pulled, an unequal tension adjustment is indicated.

FIG 3-11

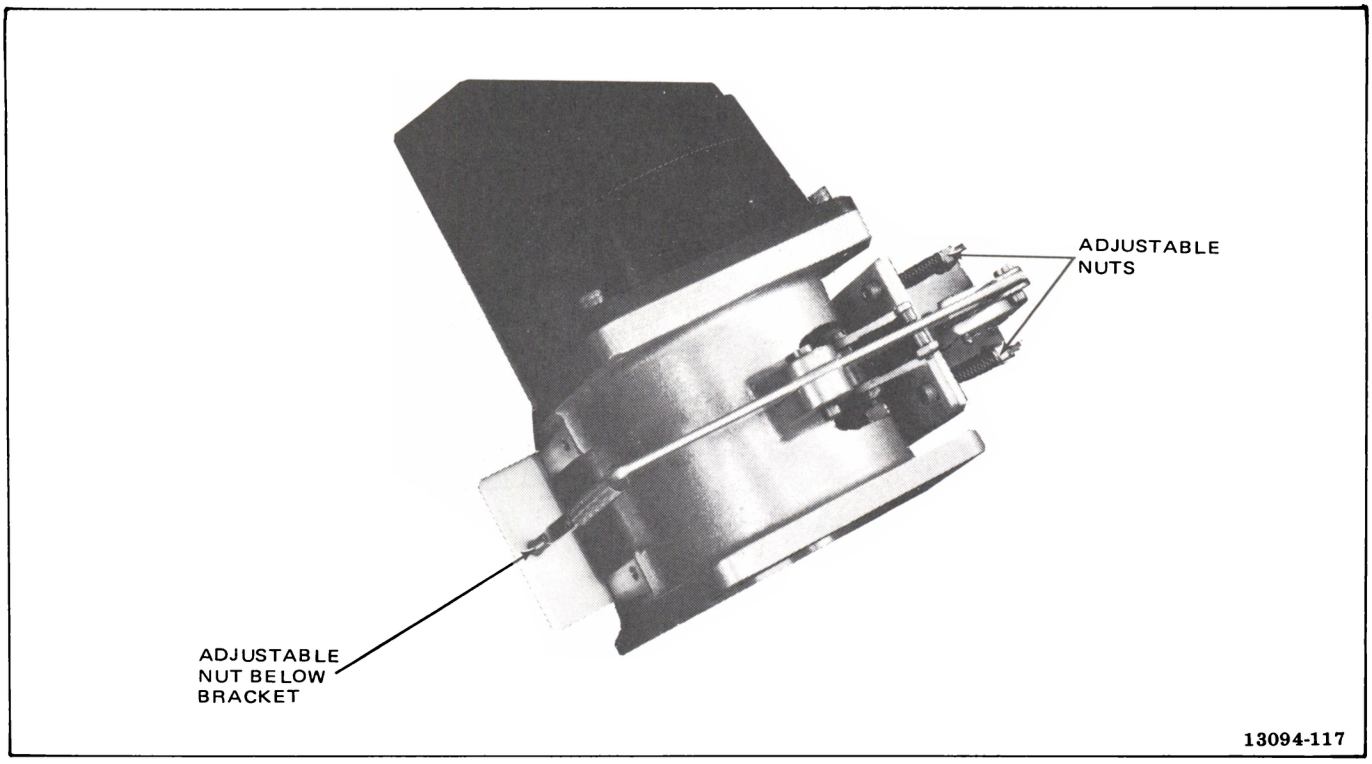



**Figure 3-11. Takeup Reel Brake Assembly**

10. Remove the scale and the nylon cord from the takeup turntable hub.

**Supply Turntable Holdback Torque Adjustment (Play Mode).** Adjust the supply turntable holdback torque as follows:

1. Turn on the power.

2. Place one end of the nylon cord through the reel guide on the supply reel turntable as was done previously when adjusting the takeup reel. Feed one of the loops in the cord through the other in order to fasten the cord to the reel guide. Wrap two or three turns of the cord counterclockwise around the reel hub and hook the 0–36-oz. scale to the remaining loop.

3. Place a wedge between the supply tension arm and its stop.

4. Hold onto the supply reel hub momentarily and press the PLAY pushbutton; as the cord is wound onto the reel hub, allow the scale to follow smoothly, keeping the cord at a tension that just balances the holdback torque.

5. Repeat step 4 until several indications of the same value have been made; in each case, the scale should indicate 10.5 ± 1.5 oz. of tension. If the indication is not within these limits, perform step 6.

6. If necessary, lift the tape transport to the tilted position and adjust the SUPPLY potentiometer (R56) in the triac control box (see Figure 3-12) under the tape transport and repeat measurements. Continue to adjust SUPPLY potentiometer and measure torque until the proper torque measurement is obtained.

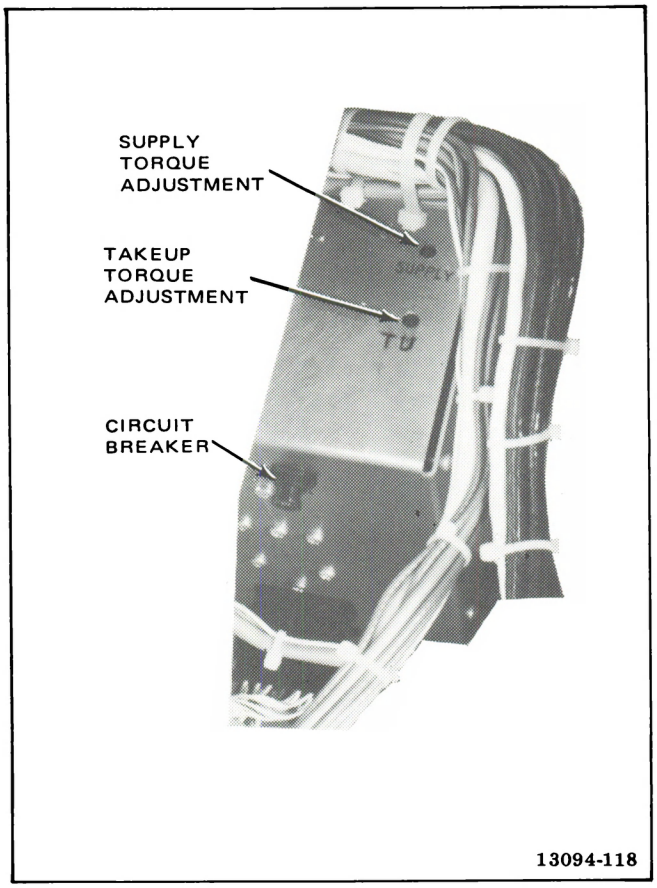



**Figure 3-12. Triac Control Box**

**Supply Turntable Holdback Torque Measurement (Fast Forward Mode).** Measure the supply turntable holdback torque in the fast forward mode as follows.

1. Turn on the power.

2. Fasten the nylon cord to the supply reel hub as in the previous paragraph.

3. Place a wedge between the supply tension arm and the supply tension arm stop.

4. Hold onto the supply reel hub momentarily and press the FAST FWD pushbutton; hold the scale to the side of the transport and parallel to the floor. As the cord is wound onto the reel hub, allow the scale to follow smoothly, keeping the cord at a tension that just balances the torque.

5. Repeat step 4 until several indications of the same value have been made; in each case, the scale should indicate 8.5 ± 0.5 oz. (241 ± 14g) of tension. If a satisfactory reading is not obtained, recheck the procedure of the previous paragraph, *Supply Turntable Holdback Torque Adjustment (Play Mode).*

**Supply Reel Braking Force Adjustment.** The reel braking force measurement is performed with the recorder in the stop mode. Adjust the supply reel braking force as follows:

1. Wrap the entire length of the nylon cord counterclockwise around the supply reel turntable hub and fasten the 0–15 lb scale to the loop on the cord.

2. Hold the scale parallel to the floor, as close as possible to the hub.

3. Pull the scale to unwind the cord from the reel hub (the turntable will rotate counterclockwise).

4. While the cord is being pulled from the supply reel hub at a steady rate, read the tension measurement on the scale.

5. Repeat step 4 until several readings of the same value have been made; in each case, the scale should indicate 7.5 lb ±8 oz. (3402 ±227g) of tension. If the reading is not within these limits, perform step 6.

6. Turn the nuts on either side of the brake solenoid (see Figure 3-13) to adjust the tension; then repeat step 5.

NOTE

**Brake tension is increased by increasing the tension on the two springs associated with the brake solenoid. Both springs must be loaded to the same tension; if the tension varies while the cord is being pulled at a steady rate, the spring tensions may be unequal.**

7. Wrap the entire length of the nylon cord clockwise around the supply turntable hub

and fasten the hook of the ~~0-2 lb~~ 0-32oz scale to the cord loop.

8. Hold the scale parallel to the floor, as close as possible to the hub.

9. Pull the scale to unwind the cord from the reel hub (the supply turntable will rotate clockwise).

10. While the cord is being pulled from the supply reel hub at a steady rate, read the indication on the scale.

11. Repeat step 10 until several indications of the same value have been made; in each case, the scale should indicate 24 ± 4 oz. (680 ± 113g). If the reading is not within these limits, perform step 12.

12. Turn the nut on the spring-loaded arm opposite the brake solenoid on the supply reel brake assembly (see Figure 3-13) to adjust the tension, then repeat step 11.

13. When the proper tension is reached, remove the scale and the nylon cord from the supply reel hub.

**Supply and Takeup Tension Arm Tension Measurement.** Measure the supply and takeup tension arm tension as follows:

1. Connect a string to the supply tension arm post and, using the appropriate range force gauge, measure the force required to disengage the tension arm from its stop. Verify a force of 1.5 ± 0.3 oz. (42 ± 8g).

2. Connect a string to the takeup tension arm post and verify a force of 1.5 ± 0.3 oz. (42 ± 8g) required to disengage the tension arm from its stop.

### Capstan Idler Pressure Adjustment

Adjust the pressure of the capstan idler against the capstan as follows:

1. Remove the head cover assembly from the tape transport.

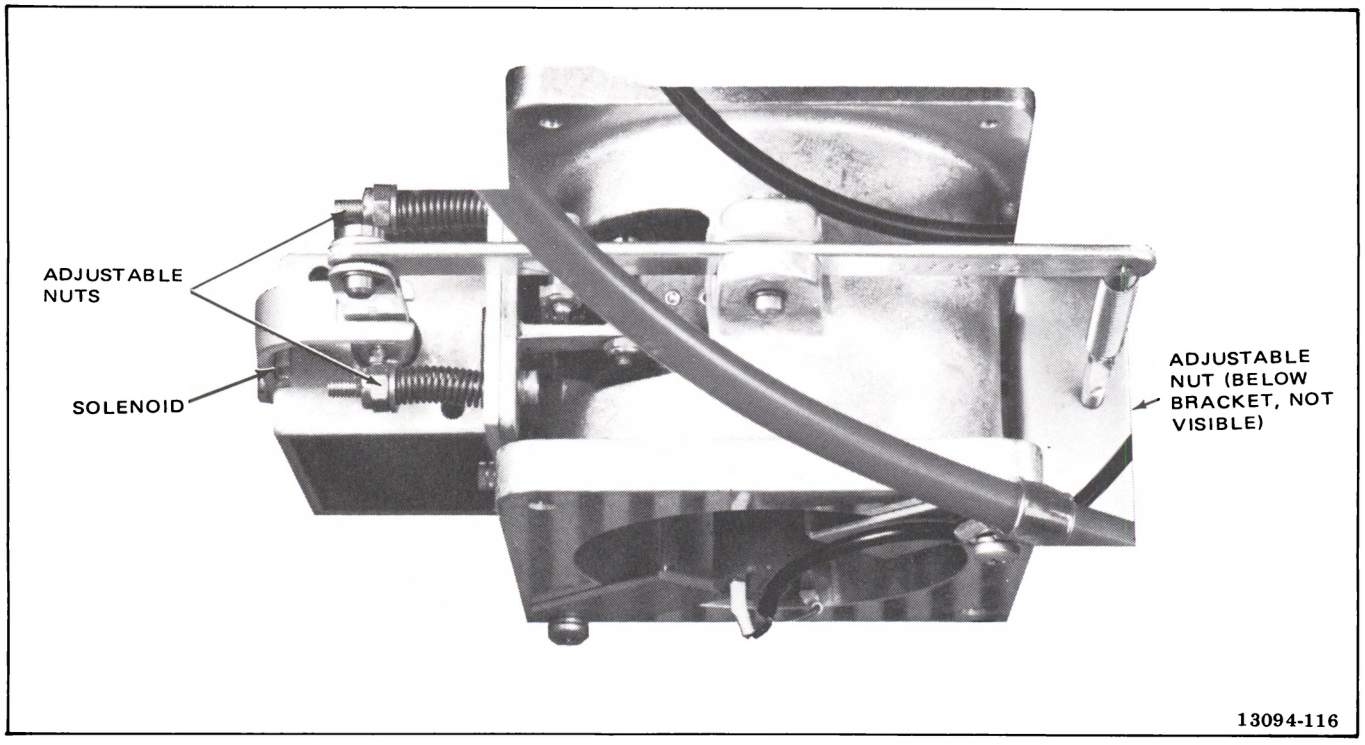



**Figure 3-13. Supply Reel Brake Assembly**

2. Install the pressure measurement attachment (Ampex Part No. 1360943) on the capstan idler yoke.

3. Secure the supply tension arm approximately 1/2-inch from its stop.

4. Attach a 0–15-lb dial indicator scale to the capstan idler yoke.

5. Turn on the power and initiate the play mode.

6. Pull the dial indicator parallel to the top plate and perpendicular to the pinch roller until the pinch roller just disengages from the capstan (place a fingertip lightly on the pinch roller surface in order to sense the point at which the capstan no longer drives the pinch roller). The indication should read 13.0 ±0.5 lbs (5,897 ±226g). Repeat this step several times to ensure an accurate reading.

7. If the reading is not within the limits stated in step 6, adjust the nut at the end of the solenoid arm (see Figure 3-14) to obtain the proper reading.

8. When the indication is correct, press the STOP pushbutton and remove the measurement yoke. Replace the head cover assembly and release the supply reel tension arm.

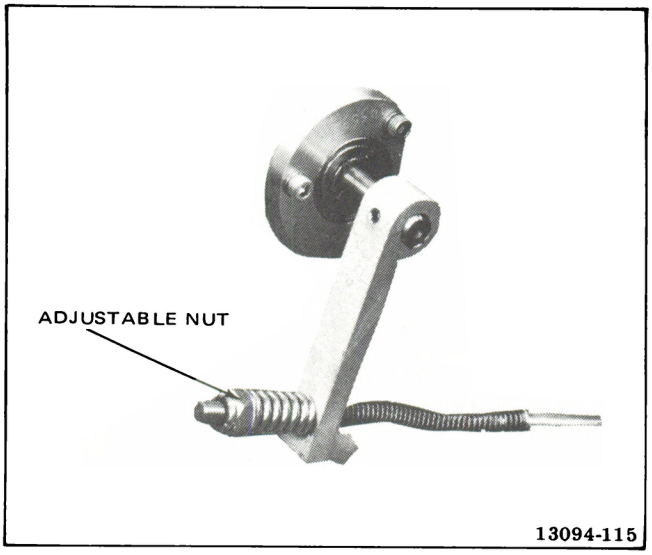



**Figure 3-14. Capstan Idler Adjustment**

### Air and Vacuum Adjustments

The source of the air supply to the recorder must provide a nominal 45 psig of air at a consumption rate of 1.0 scfm to the air input of the recorder. Adjust the vacuum pressure to the vacuum guide on the video head assembly as follows:

1. Ascertain that a video head assembly is installed on the tape transport.

2. Pull the control panel forward to gain access to the transport latch handle.

3. Push down and to the right on the latch handle to release the tape transport. When the tape transport is released from the latch, lift the front of the transport up and back and leave it in the raised position.

4. Turn on the recorder power.

5. Adjust the vacuum valve (see Figure 3-15) to obtain a vacuum of 40 inches of water as indicated on the vacuum gauge.

6. Lower the input air pressure to the system at the regulator valve at the air source until the red low pressure warning lamp lights. Observe that this occurs at 25 ±2 psi (172.4 ±13.8kPa), and that the headwheel motor has just stopped running. Adjust the cutout range control if necessary. To raise the cutout setting (which will also raise the cutin setting), turn the cutout range nut clockwise (see Figure 3-15). Remove metal cover to expose and adjust cutout range nut.

7. Increase the input air pressure to the system and observe that the BEARING AIR indicator on the control panel goes out at approximately 35 psi. Observe that the headwheel motor is running. Adjust the cutin setting, if necessary. To raise the cutin setting, turn the cutin screw clockwise (see Figure 3-15). Remove metal cover to expose and adjust cutin range nut.

8. Move the supply reel compliance arm approximately 0.5-inch clockwise. Listen for the microswitch click, then press the FAST FWD pushbutton. Observe that the supply and takeup turntables rotate.

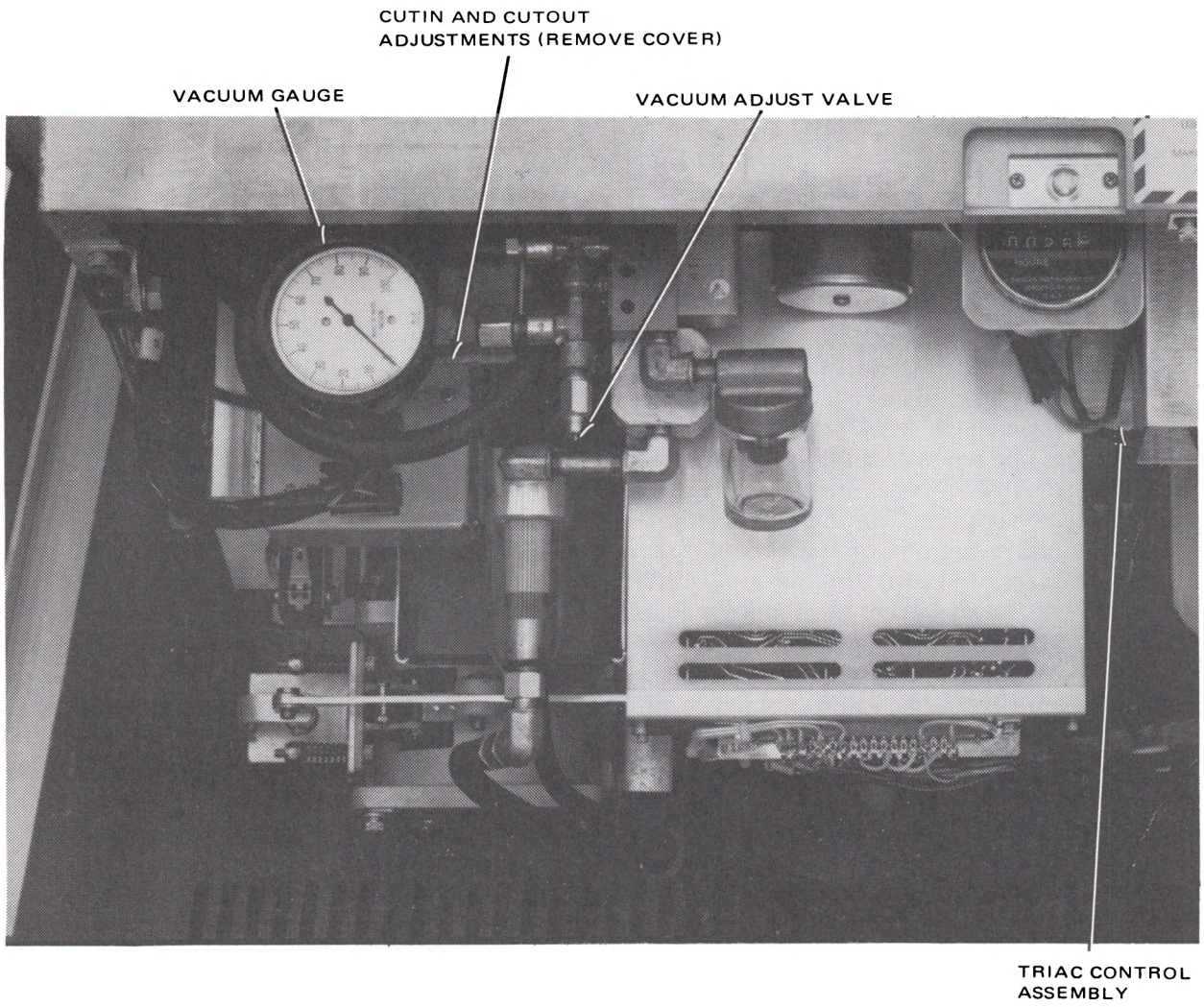



**Figure 3-15. Air and Vacuum Adjustments**

9. With the system in the fast forward mode, decrease the system input air until the BEARING AIR indicator on the control panel lights. Observe that the headwheel motor and both reel turntables stop running.

10. Increase the system air to 45 psi with the system in the fast forward mode. Observe that the headwheel motor and both reel turntables rotate and that the red BEARING AIR indicator goes out.

11. Press the STOP pushbutton. Allow the supply reel compliance arm to return to its normal position.

### Triac Control Assembly Adjustment

Adjust the triac control assembly (see Figure 3-15 for location) in accordance with the procedures under *Takeup Torque (Normal) Adjustment Procedure* and *Supply Turntable Holdback Torque Adjustment (Play Mode).* If specified torques

cannot be attained replace defective components. Figure 3-16 is supplied as an aid to troubleshooting.

## AUDIO AND CUE SYSTEM CHECKOUT AND ALIGNMENT

### Audio PWA 9/10, Assembly No. 1373478

The following paragraphs detail the checkout and alignment procedures for ensuring proper operation of the Audio PWA 9/10, Assembly No. 1373478. These procedures have been performed at the factory and need to be repeated only when a repaired or replacement PWA has been installed in the recorder, or when the PWA has otherwise become misadjusted. Procedures must be performed in the order given. The following tables list the positions and functions of the shorting plugs (jumpers) that are mounted on the audio PWA. The jumpers that select the various modes in which the PWA may be operated are listed in Table 3-4. The jumpers and their positions for facilitating the test setup are listed in Table 3-5. The signals that may be monitored at various test points are given in Table 3-6. Figure 3-17 includes a block diagram of the audio PWA.

**Preliminary Procedure.** Perform the following preliminary procedure.

**CAUTION**

**DO NOT REMOVE OR REPLACE ANY PRINTED WIRING ASSEMBLY WHEN POWER IS ON. TO DO SO IS HAZARDOUS TO COMPONENTS AND MAY CAUSE MAGNETIZATION OF THE HEADS.**

1. Set all jumpers listed in Tables 3-4 and 3-5 to their normal positions.

2. On the front of the PWA, set the REPRODUCE UNITY/VARIABLE toggle switch to UNITY and the NORMAL/MONITOR switch to NORMAL.

3. Set AUD 1/AUD 2/CUE/CT MONITOR switch on control panel to AUD 1 or AUD 2 as appropriate.

4. Connect an audio voltmeter to AUDIO 1 OUT or AUDIO 2 OUT as appropriate for PWA under test. When making signal-to-noise measurements use an ASA "A" weighted filter or noise filter connected between the the AUDIO OUT connector and the audio voltmeter. The 30-Hz to 18-kHz noise filter, shown schematically in Figure 3-18, causes no appreciable insertion loss at 1000 Hz; measurements at 1000 Hz can be read directly from the voltmeter when this filter is used. The ASA "A" weighted filter, shown schematically in Figure 3-19, causes a 4-dB insertion loss at 1000 Hz; measurements taken using this filter must be adjusted to account for this loss.

5. Clean and degauss all heads and guides before threading audio standard alignment tape on the transport.

**Playback Reference Level Adjustment – Ampex 175 or Equivalent Tape.** Perform the following playback reference level adjustment if the recorder will use Ampex 175 or equivalent videotape.

1. Thread alignment tape (Ampex 52269-01) on the tape transport and initiate the play mode.

2. Adjust REP CAL potentiometer R124 through front panel of PWA for a +8-dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (–2 dBm when playing the 1-kHz tone recorded at –10 dBm) on the audio standard alignment tape.

**NOTE**

**Installations operating at audio levels other than +8 dBm should adjust potentiometer R124 for the desired operating level.**

3. Adjust potentiometer R159 (see Figure 3-20) for a zero indication on the vu meter on the control panel when playing the 1-kHz tone recorded at operating level (–10 vu when playing the 1-kHz tone recorded at –10 dB).

4. Place jumper J5 in the A - C position.

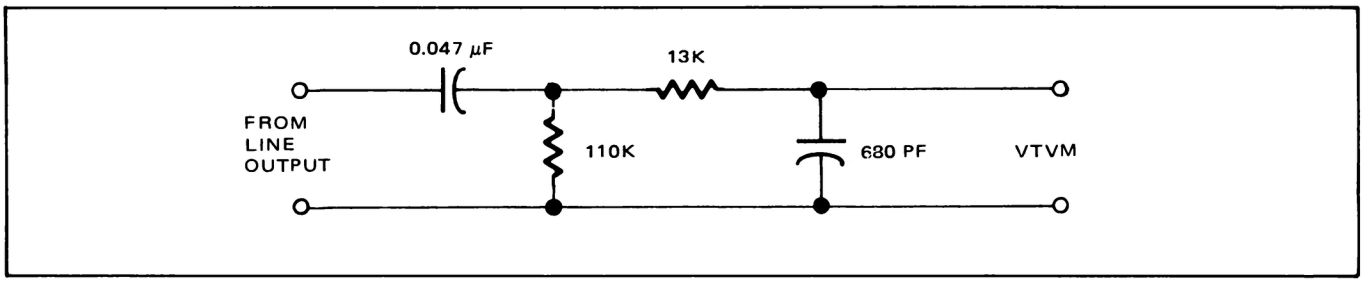



Figure 3-18. 30 Hz to 18 kHz Noise Filter

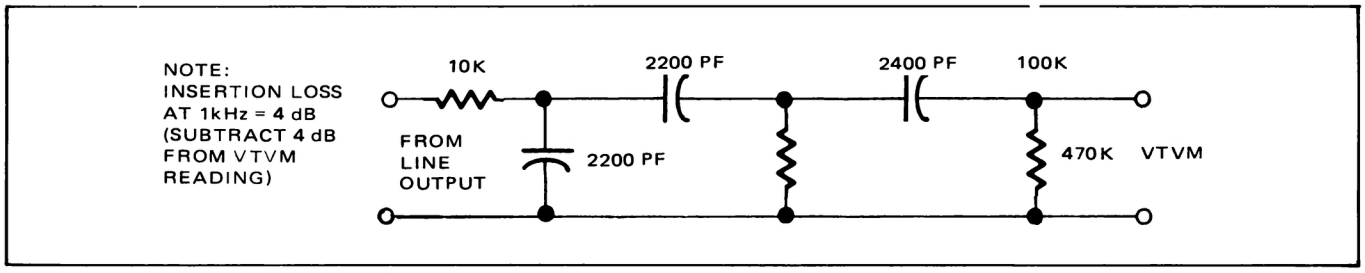



Figure 3-19. ASA "A" Weighted Filter

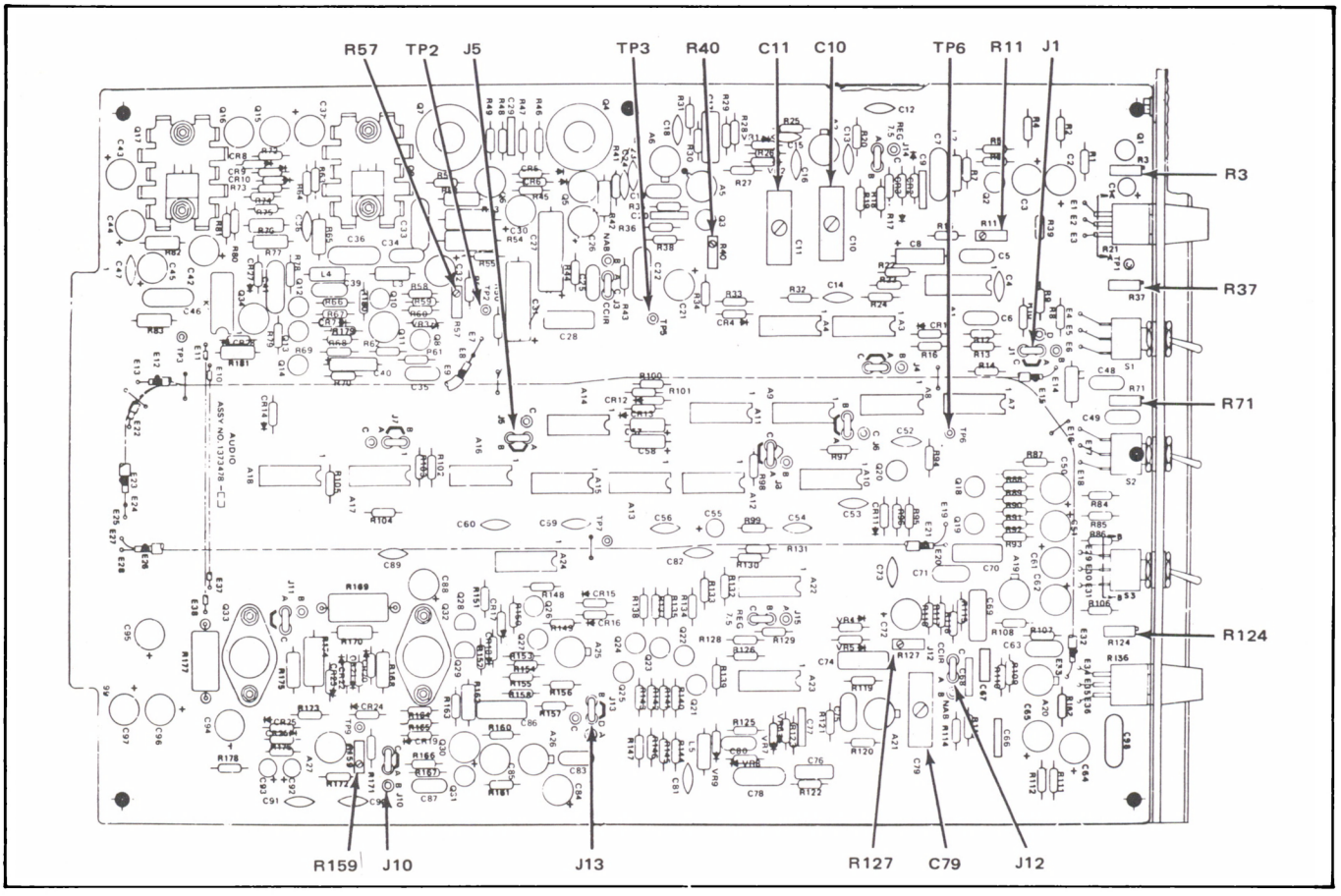



Figure 3-20. Audio PWA 9/10 Assembly No. 1373478

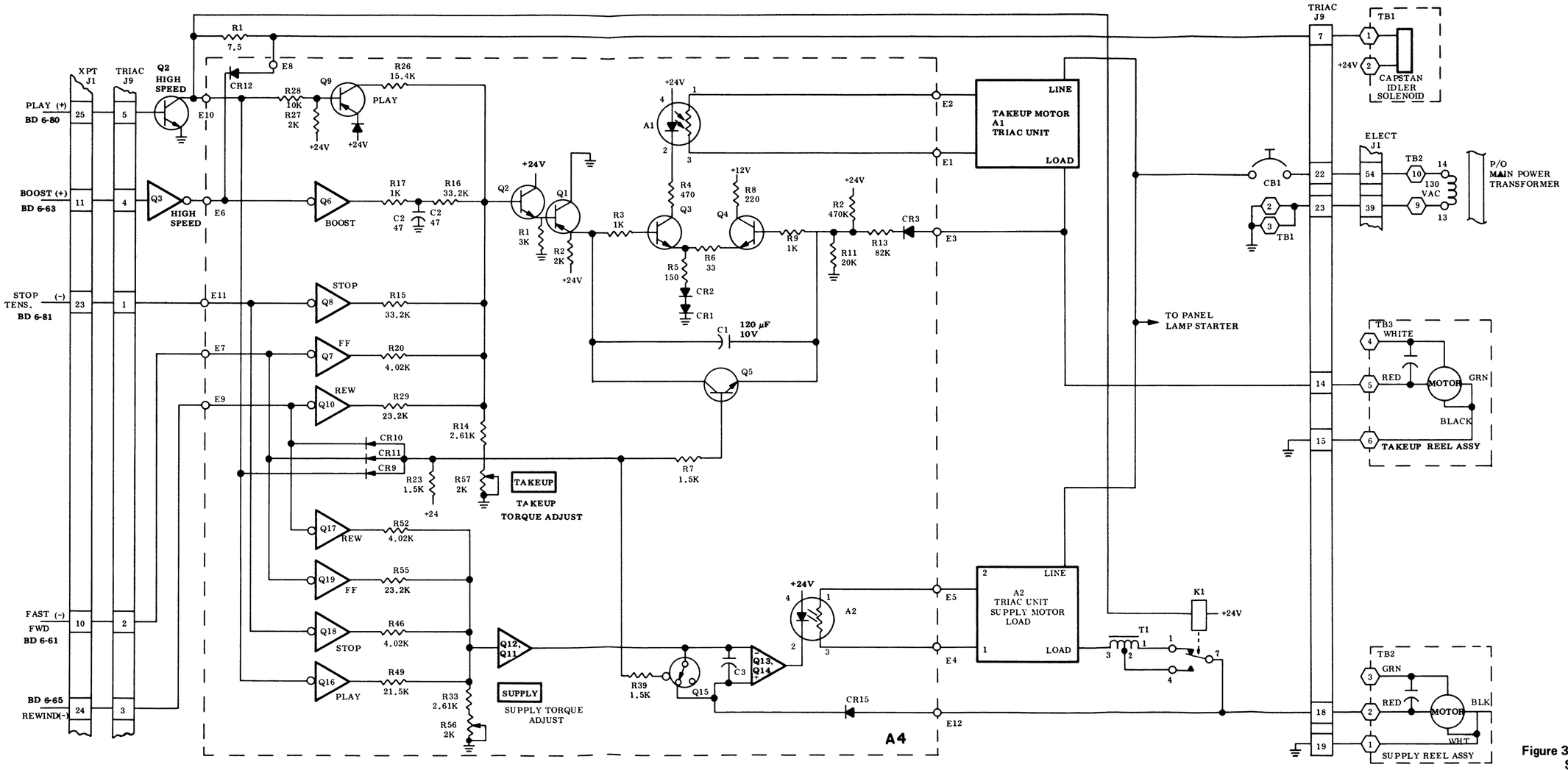



Figure 3-16. Triac Control Assembly, Simplified Schematic Diagram

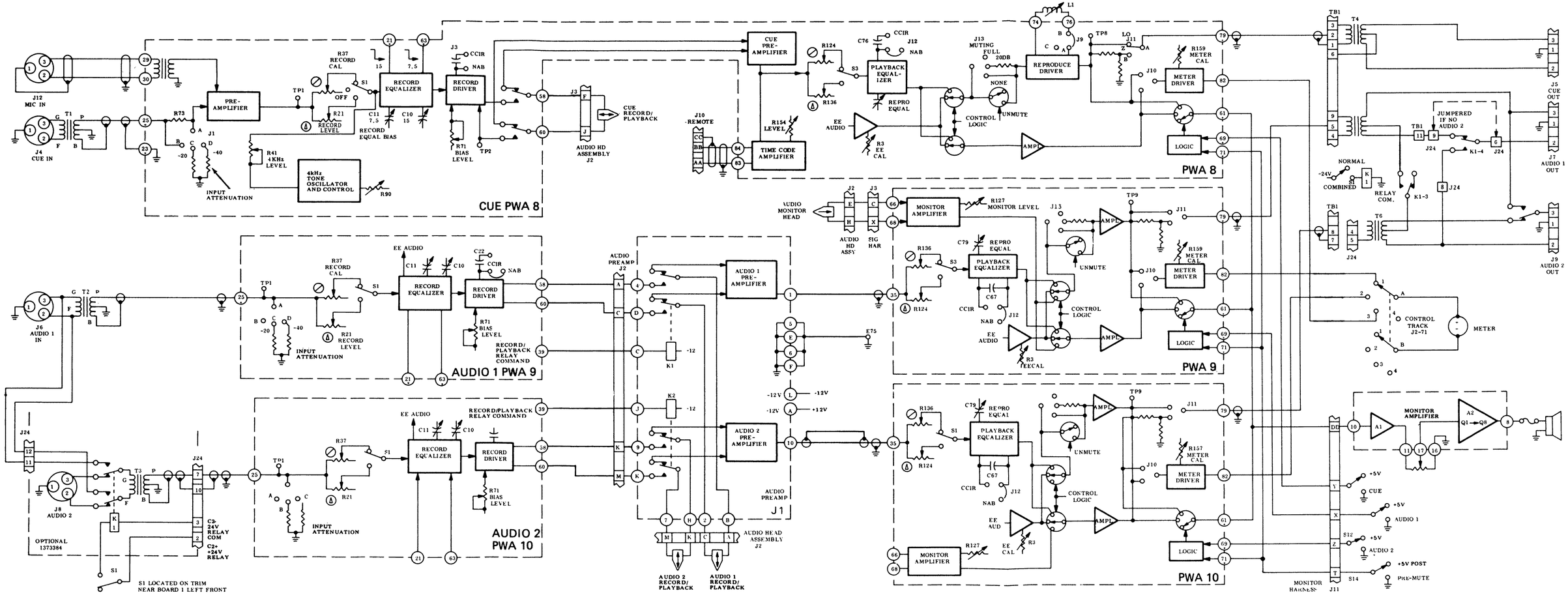



**Figure 3-17. Audio and Cue System (Audio PWA 1373478, Cue PWA 1374928)**

Table 3-4. Jumpers for the Selection of Operating Modes on Audio PWA, Assembly No. 1373478

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J1 | Input signal attenuator | A to B | In this position, input signal is not attenuated. |
| | | A to C | Normal, provides 20-dB attenuation of input signal. |
| | | A to D | Provides 40-dB attenuation of input signal. |
| | | | **NOTE**<br>**Jumper J3 position must be selected to coincide with position of jumper J12.** |
| J3 | Low frequency recording preemphasis | A to B | NAB record equalization. |
| | | A to C | CCIR record equalization. |
| J6 | Erase circuit activator or inhibitor | A to B | Normal; activates erase circuit. |
| | | A to C | Inhibits erase circuit. |
| J8 | Muting circuit activator | A to B | Muting occurs for 100 ms during switching period and in all modes except play mode. |
| | | A to C | Mutes in all modes except play and record. |
| J10 | Vu metering selector | A to B | **NOTE**<br>**When jumper J10 is changed from one position to another, meter must be recalibrated by adjusting R159.** |
| | | A to C | Meter monitors output signal before signal reaches muting circuit (meter indicates in muted modes). |
| | | | Normal; monitors output line signal after muting. |
| J11 | Output impedance selector | A - B | Output impedance is 600 ohms and output level is attenuated by 10 dB. This position is used for driving long 600-ohm lines such as telephone lines. |
| | | A - C | Normal, output impedance is approximately 10 ohms. |
| | | | **NOTE**<br>**Jumper J12 position must be selected to coincide with position of jumper J3.** |
| J12 | Low frequency reproduce deemphasis | A - B | NAB playback equalization. |
| | | A - C | CCIR playback equalization. |
| J13 | Degree of muting selector | D - A | No muting at any time. |
| | | D - B | Normal, 100% muting (no signal passes) during muting periods. |
| | | D - C | 20-dB attenuation during muting periods. |
| | | | **NOTE**<br>**Jumper J14 must be used in conjunction with jumper J15.** |

Table 3-4. Jumpers for the Selection of Operating Modes on Audio PWA, Assembly No. 1373478 (Continued)

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J14 | 7-1/2 in/s preemphasis adjust | A - C | Normal – 7-1/2 in/s record equalization. |
| | | A - B | Super equalization, record preemphasis at 7-1/2 in/s +4 dB higher than normal.<br>**NOTE**<br>**Use jumper J15 A - B position only with high oerstead tapes.** |
| J15 | 7-1/2 in/s deemphasis adjust | A - C | Normal – 7-1/2 in/s playback equalization. |
| | | A - B | Super equalization – 7-1/2 in/s playback equalization. |

Table 3-5. Jumpers for Facilitating Test Setup on Audio PWA, Assembly No. 1373478

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J4 | Bias oscillator and head record playback relay activator | A to B | Test – enables bias for setup. Bias is turned on and headswitching relay is energized. PWA is in record at all times. Used for monitoring bias and record current. |
| | | A to C | Normal operating position. |
| J5 | E-E and monitor calibrator | A to B | Normal operating position. |
| | | A to C | For setup, line amplifier is connected to either record amplifier,(E-E)or monitor amplifier, depending on position of NORMAL/MONITOR switch on front of PWA. |
| J7 | Erase amplifier monitor | A to B | Normal operating position. |
| | | A to C | Permits monitoring erase current (PWA always in erase) for setup. |

Table 3-6. Test Points on Audio PWA 9/10, Assembly No. 1373478

| TEST POINT | PURPOSE | DESCRIPTION |
|---|---|---|
| TP1 | Signal input monitoring or test signal injection | A dual purpose test point. If jumper J2 is placed between A and B, test point is an input monitoring point. If jumper J2 is removed from PWA or placed between A and C, test point may be used as a signal injection point for troubleshooting. |
| TP2 | Record head current measurement | Record head current, either signal or bias, in milliamperes, is equal to the voltage in volts relative to ground, times 100. |
| TP3 | Erase head current | Erase head current in milliamperes is equal to the voltage in volts relative to ground, times 100. |
| TP5 | Ground reference | Ground reference for all other test points on PWA. |
| TP6 | Bias oscillator frequency measurement | Bias frequency may be monitored here while adjusting bias oscillator frequency (100 kHz). |

Table 3-6. Test Points on Audio PWA 9/10, Assembly No. 1373478 (Continued)

| TEST POINT | PURPOSE | DESCRIPTION |
|---|---|---|
| TP7 | 100-ms muting pulse generator output | Output of one-shot that generates 100-ms muting pulse. This point can act as a sweep trigger for an oscilloscope that is monitoring record head and the erase head turn-on/turn-off current profiles. |
| TP9 | Line amplifier output | Output of line amplifier before signal goes through output transformer or impedance selector. |

5. Set NORMAL/MONITOR toggle switch on the front of the PWA to MONITOR.

6. Adjust potentiometer R127 for a +8-dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (–2 dBm when playing 1-kHz tone recorded at –10 dB) on the standard audio alignment tape.

NOTE

**Installations operating at audio levels other than +8 dBm should adjust potentiometer R127 for the desired operating level.**

**Playback Reference Level Adjustment – Ampex 176 or Equivalent Tape.** Perform the following playback reference level adjustment if the recorder will use Ampex 176 or equivalent videotape.

1. Thread alignment tape (Ampex 52269-01) on the tape transport and initiate the play mode.

2. Adjust REP CAL potentiometer R124 (through front of PWA) for a +4-dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (-6 dBm when playing the 1-kHz tone recorded at –10 dBm) on the standard audio alignment tape.

NOTE

**Installations operating at audio levels other than +8 dBm should adjust potentiometer R124 for 4 dB below the desired operating level.**

3. Adjust potentiometer R159 for –4 vu on the vu meter on the control panel when playing the 1-kHz tone recorded at operating level (–14 vu when playing the 1-kHz tone recorded at –10 dB).

4. Set jumper J5 to the A - C position.

5. Set NORMAL/MONITOR toggle switch on the front of the PWA to MONITOR.

6. Adjust potentiometer R127 for a +4-dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (–6 dBm when playing the 1-kHz tone recorded at –10 dBm).

NOTE

**Installations operating at audio levels other than +8 dBm should adjust potentiometer R127 for 4 dB below the desired operating level.**

**Playback Equalization Adjustment.** Adjust playback equalization as follows:

1. Set jumper J12 to A - B position for NAB curve, or A - C for CCIR curve.

2. Play back Ampex audio standard alignment tape 52269-01 and adjust capacitor C79 so that the 10-kHz tone plays back at the same level as the 1-kHz tone. Verify that all other tones play back within ±2 dB of the 1-kHz reference tone.

NOTE

**When playing audio standard alignment tape on a recorder with dual or stereo audio systems, a +3-dB fringing effect at 50 Hz can be expected.**

3. Remove audio standard alignment tape from the recorder.

**Bias Frequency and Level Set.** Adjust the bias frequency and bias level as follows:

NOTE

**The audio and cue PWAs are interlocked in such a manner that when two or more audio PWAs, or an audio PWA and a cue PWA, are installed, only one PWA supplies the bias frequency for all of the audio and cue PWAs. In order to check and adjust the bias frequency, only the audio or cue PWA for the channel being checked should be left in the card rack; the other audio or cue PWAs should be removed.**

1. Thread a reel of bulk degaussed tape on the transport.
2. Adjust audio oscillator connected to AUDIO IN connector for 1 kHz at a level of ~~+8~~ +4 dBm.
3. Connect oscilloscope probe to TP6.
4. Adjust potentiometer R11 for a 10μs square wave (100 kHz).
5. Set jumper J5 to the A - C position.
6. Set jumper J1 to the A - C position.
7. Set the NORMAL/MONITOR toggle switch on the front of the PWA to the MONITOR position. Connect on PWA-10
8. Set RECORD LEVEL/UNITY/VARIABLE toggle switch to VARIABLE.
9. Adjust REC LEVEL control to a low level, such as -10 dB, on the control panel vu meter.
10. Initiate the record mode.
11. Adjust BIAS potentiometer R71 (through front of PWA) for a maximum output as indicated on the vu meter.

Scope Saturation = 3% p-p

Cf. PWA 9+10 Across ~10 ~~mV~~

Connect to f...

12. Re-install J1 and J5 to normal operating position.

NOTE

**If the recorder is not equipped with a monitor head, or if the cue PWA is being adjusted, the bias level must be monitored at test point TP2 of the PWA under test while a test recording is made. Record the audio tone at various levels of bias. Adjust bias level with potentiometer R71. Using a microphone, record verbal notes on an unused audio/cue channel to indicate when the bias level is changed and what the bias level is at TP2. Rewind tape to the beginning of the recording; play back the tape and note what bias level resulted in the greatest output on the vu meter. After the test tape has been played, and the proper bias level noted, initiate the record mode and while monitoring bias level at TP2, adjust potentiometer R71 to the bias level that resulted in the greatest output signal.**

**Record Level Adjustment.** Adjust record level as follows:

1. Set RECORD UNITY/VARIABLE toggle switch to UNITY.
2. Supply AVR-2 with an audio signal with level of ~~+8~~ -4 dB (or whatever is normal for system).
3. Initiate record mode.
4. Adjust REC CAL potentiometer R37 (on front of PWA) for zero vu on the control panel vu meter, during playback of recorded tone. Scope on center pin of S.I. will show 50 to 75 mV. signal.
5. Stop recorder.

**E-E Level Adjustment.** Adjust E-E level as follows:

1. Put recorder in the E-E mode.
2. Set jumper J13 to the A - D position.
3. Set jumper J10 to the A - C position.

4. Adjust potentiometer R3 for zero vu on the control panel vu meter.

**Record Equalization Adjustment, 15 in/s.** Adjust 15-in/s record equalization as follows:

1. Adjust the audio oscillator supplying audio signal to AUDIO INPUT for 1 kHz at –2 dBm (or 10 dB below standard operating level).
2. Set the 15 IPS/7-½ IPS toggle switch on the capstan servo PWA to 15 IPS.
3. Set the RECORD UNITY/VARIABLE toggle switch to UNITY.
4. Initiate the record mode.
5. Record frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 10 kHz, 12 kHz, and 15 kHz.
6. Play back the tape and verify that all frequencies play back within ±2 dB of that measured for 1 kHz. If necessary adjust capacitor C10 as required to meet ±2-dB specification. On units extremely out of adjustment, it may be quicker to first record 1.5 kHz and 15 kHz and adjust capacitor C10 until those frequencies fall within specification.

**Record Equalization Adjustment, 7-½-in/s.** Adjust 7-½-in/s record equalization as follows.

1. Set the 15 IPS/7-½ IPS toggle switch on the capstan servo PWA to 7-½ IPS.
2. Set the RECORD UNITY/VARIABLE toggle switch to UNITY.
3. With audio oscillator supplying audio signal to AUDIO INPUT set for 1 kHz at –2 dBm, (or 10 dB below operating level), record frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 10 kHz, 12 kHz, and 15 kHz.
4. Play back the tape and verify that all frequencies play back within ±2dB of that measured for 1 kHz. If necessary, adjust capacitor C11 as required to meet ±2-dB specification. On units extremely out of adjustment, it may be quicker to first record 1.5 kHz and 15 kHz and adjust capacitor C11 until those frequencies fall within specification; then adjust C11 until all frequency specifications are met.

**Erase Current Adjustment (Monaural Systems).** On monaural systems, adjust erase current as follows:

1. Connect oscilloscope probe to TP3.
2. Initiate the record mode.
3. Adjust potentiometer R57 for 3.0 Vp-p (erasure will be to –46 dBm).

**Erase Current Adjustment (Dual/Stereo Systems).**

On dual or stereo systems, adjust erase current as follows:

1. Connect oscilloscope probe to TP3.
2. Initiate the record mode.
3. Adjust potentiometer R57 for 2.5 Vp-p (erasure will be to –31 dBm).

**Pops and Clicks Adjustment.** Minimize pops and clicks as follows:

1. Remove audio oscillator from AUDIO INPUT connector.
2. Make several start and stop recordings; if unit is equipped with an editor, make several insert edits.
3. Play back the tape and verify that all pops and clicks are no higher than –25 dBm.
4. If necessary, adjust potentiometer R40 for all pops and clicks to be below –25 dBm.

**Cue PWA 8, Assembly No. 1374928**

The following paragraphs detail the checkout and alignment procedures for ensuring proper operation of the Cue PWA 8, Assembly No. 1374928. These procedures have been performed at the factory and need be repeated only when a repaired or replacement PWA has been installed in the

recorder or when the PWA has otherwise become misadjusted. Procedures must be performed in the order given. The following tables list the positions and functions of the shorting plugs (jumpers) that are mounted on the cue PWA 8. The jumpers that select the various modes in which the PWA may be operated are listed in Table 3-7. The jumpers and their positions for facilitating the test setup are listed in Table 3-8. Table 3-9 gives the signals that may be monitored at various test points.

**Table 3-7. Jumpers for the Selection of Operating Modes on Cue PWA, Assembly No. 1374928**

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J1 | Input signal attenuator | A to B | Provides zero attenuation of input signal. |
| | | A to C | Normal; provides 20-dB attenuation of input signal. |
| | | A to D | Provides 40-dB attenuation of input signal. |
| J2 | Reproduce equalization | A to B | Sets reproduce equalization electronics for normal playback equalization. |
| | | A to C | Normal; reproduce equalization depends on system mode. |
| J3 | Low frequency recording pre-emphasis | A to B | Provides 2,000 $\mu$s (NAB standard) low frequency record preemphasis. |
| | | A to C | No low frequency preemphasis (constant current). |
| | | | **NOTE**<br>**Jumper J3 position must be selected to coincide with position of jumper J12.** |
| J6 | Erase circuit activator or inhibitor | A to B | Normal; permits erase circuit to be activated. |
| | | A to C | Inhibits erase circuit. |
| J8 | Muting circuit activator | A to B | Muting occurs for 100 ms during switching period and in all modes except play mode. |
| | | A to C | Muting occurs for 100 ms during switching period and in all modes except play mode and record mode. |
| J9 | 240/250-Hz trap | A to B | The 240/250 Hz trap is connected to the line driver circuit. |
| | | A to C | The 240/250 Hz trap is disconnected from the line driver circuit. |
| J10 | VU metering selector | A to B | Meter monitors output signal prior to muting; meter indicates even in muted modes. |
| | | A to C | Normal; monitors output line signal after muting. |
| | | | **NOTE**<br>**When jumper J10 is changed from one position to another, meter must be recalibrated.** |
| J11 | Output impedance selector | A to B | Output impedance is 600 ohms and output level is attenuated by 10 dB. |
| | | A to C | Normal; output impedance is approximately 10 ohms. |

Table 3-7. Jumpers for the Selection of Operating Modes on Cue PWA, Assembly No. 1374928 (Continued)

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J12 | Low frequency reproduce deemphasis | A to B | NAB playback equalization. |
| | | A to C | CCIR playback equalization. |
| | | | **NOTE**<br>**Jumper J12 must be selected to coincide with jumper J3.** |
| J13 | Degree of muting selector | D to A | No muting at any time. |
| | | D to B | Normal; 100% muting (no signal passes) during muting periods. |
| | | D to C | 20-dB attenuation during muting periods. |

Table 3-8. Jumpers for Facilitating Test Setup on Cue PWA, Assembly No. 1374928

| JUMPER | DESCRIPTION | POSITION | FUNCTION |
|---|---|---|---|
| J4 | Bias oscillator and record/playback relay activator | A to B | Test – enables bias for setup. Bias is turned on and headswitching relay is energized. PWA is in record at all times. Used for monitoring bias and record current. |
| | | A to C | Normal operating position. |
| J5 | E-E mode setup | A to B | Normal operating position. |
| | | A to C | Establishes E-E mode; line amplifier is connected to record amplifier. |
| J7 | Erase Amplifier monitor | A to B | Normal operating position. |
| | | A to C | Permits monitoring erase current (PWA always in erase) |

Table 3-9. Test Points on Cue PWA, Assembly No. 1374928

| TEST POINT | PURPOSE | DESCRIPTION |
|---|---|---|
| TP1 | Signal input monitoring or test signal injection | A dual purpose test point. If jumper J2 is placed between A and B, test point is an input monitoring point. If jumper J2 is removed from PWA or placed between A and C, test point may be used as a signal injection point for troubleshooting. |
| TP2 | Record head current measurement | Record head current, either signal or bias, in milliamperes, is equal to the voltage in volts relative to ground, times 100. |
| TP3 | Erase head current measurement | Erase head current in milliamperes is equal to the voltage in volts relative to ground, times 100. |
| TP5 | Ground reference | Ground reference for all other test points on PWA. |
| TP6 | Bias and erase oscillator divider frequency measurement | Convenient point to monitor bias erase oscillator frequency (100 kHz). |

Table 3-9. Test Points on Cue PWA, Assembly No. 1374928 (Continued)

| TEST POINT | PURPOSE | DESCRIPTION |
|---|---|---|
| TP7 | 100-ms muting pulse generator output | Output of one-shot that generates 100-ms muting pulse. This point can act as a sweep trigger for an oscilloscope that is monitoring record head and erase head turn-on/turn-off current profiles. |
| TP8 | Line amplifier output | Output of line amplifier before signal goes through output transformer or impedance selector. |
| TP9 | Cue tone oscillator frequency measurement | Output of cue tone oscillator before cue tone oscillator output is divided. Cue tone may be monitored here while adjusting oscillator frequency (8 kHz). |

**Preliminary Procedure.** Perform the following preliminary procedure.

CAUTION

**DO NOT REMOVE OR REPLACE ANY PRINTED WIRING ASSEMBLY WHEN POWER IS ON. TO DO SO IS HAZARDOUS TO COMPONENTS AND MAY CAUSE MAGNETIZATION OF THE HEADS.**

1. Set all jumpers listed in Table 3-7 and 3-8 to their normal positions.
2. Set the reproduce UNITY/VARIABLE toggle switch on the front of the PWA to UNITY.
3. Set AUD 1/AUD 2/CUE/CT MONITOR switch on control panel to CUE.
4. Connect an audio voltmeter to CUE OUT connector on the rear connector panel. When making signal to noise measurements use an ASA "A" weighted filter or noise filter connected between the AUDIO OUT connector and the audio voltmeter. The 30-Hz to 18-kHz noise filter, shown schematically in Figure 3-18, causes no appreciable insertion loss at 1000 Hz; measurements at 1000 Hz can be read directly from the voltmeter when this filter is used. The ASA "A" weighted filter shown schematically in Figure 3-19 causes a 4-dB insertion loss at 1000 Hz; measurements taken using this filter must be adjusted to account for this loss.
5. Clean and degauss all heads and guides before threading audio standard alignment tape on the transport.

**Playback Reference Level Adjustment – Ampex 175 or Equivalent Tape.** Perform the following playback reference level adjustment if the recorder will use Ampex 175 or equivalent videotape.

1. Thread alignment tape (Ampex 52269-01) on the tape transport and initiate the play mode.
2. Adjust REP CAL potentiometer R24 through front panel of PWA for a +8 dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (–2 dBm when playing the 1-kHz tone recorded at –10 dB) on the audio standard alignment tape.

NOTE

**Installations operating at cue levels other than +8 dBm should adjust potentiometer R24 for the desired operating level.**

3. Adjust potentiometer R159 (see Figure 3-21) for a zero indication on the vu meter on the control panel when playing the 1-kHz tone recorded at operating level (–10 vu when playing the 1-kHz tone recorded at –10 dB).

**Playback Reference Level Adjustment – Ampex 176 or Equivalent Tape.** Perform the following

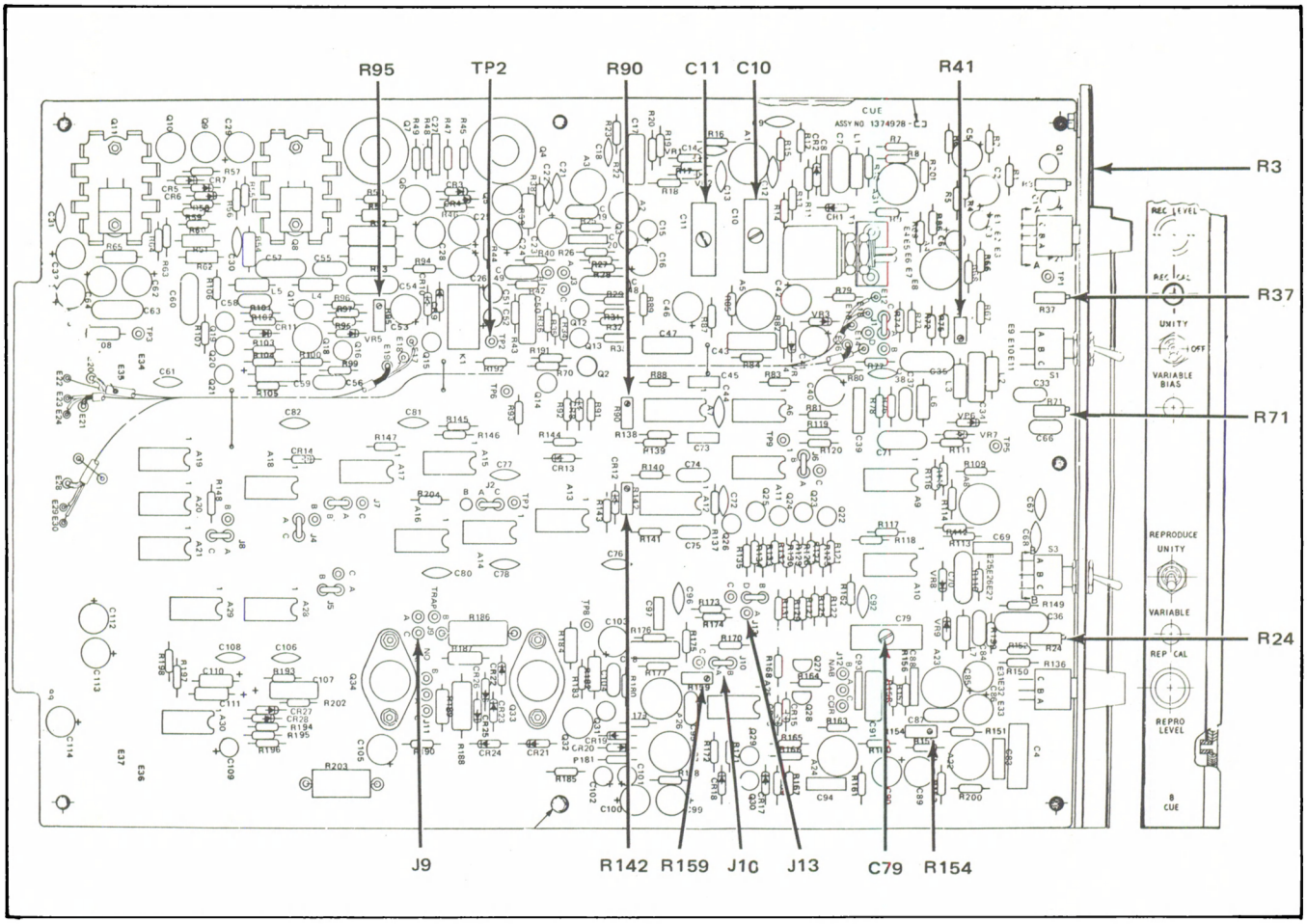



**Figure 3-21. Cue PWA, Assembly No. 1374928**

playback reference level adjustment if the recorder will use Ampex 176 or equivalent videotape.

1. Thread alignment tape, Ampex 52269-01, on the tape transport and initiate the play mode.

2. Adjust REP CAL potentiometer R124 (through front of PWA) for a +4-dBm reading on the voltmeter when playing the 1-kHz tone recorded at operating level (–6 dBm when playing the 1-kHz tone recorded at –10 dB) on the standard audio alignment tape.

NOTE

**Installations operating at audio levels other than +8 dBm should adjust potentiometer R124 for 4 dB below the desired operating level.**

3. Adjust potentiometer R159 for –4 vu on the vu meter on the control panel when playing the 1-kHz tone recorded at operating level (–14 vu when playing the 1-kHz tone recorded at –10 dB).

**Playback Equalization Adjustment.** Adjust playback equalization as follows:

1. Set jumper J12 to A - B position for NAB curve or A - C for CCIR curve.

2. Play back Ampex audio standard alignment tape 52269-01 and adjust capacitor C79 so that the 10-kHz tone plays back at the same level as the 1-kHz tone. Verify that all other tones play back within ±2 dB of the 1-kHz reference tone.

3. Remove audio standard alignment tape from the recorder.

**Bias Frequency and Level Set.** Set bias frequency and level as follows:

NOTE

**The audio and cue PWAs are interlocked in such a manner that when more than one audio PWA or one audio and one cue PWA is installed, only one PWA supplies the bias frequency for all of the audio and cue PWAs. In order to check and adjust the bias frequency, only the audio or cue PWA for the channel being checked should be left in the card rack; the other or cue PWAs should be removed.**

1. Thread a reel of bulk degaussed tape on the transport.
2. Adjust audio oscillator connected to CUE IN connector for 1 kHz at a level of +8 dBm.
3. Connect oscilloscope probe to TP6.
4. Adjust potentiometer R142 for a 10-$\mu$s square wave (100 kHz).
5. Set RECORD LEVEL UNITY/VARIABLE toggle switch to VARIABLE.
6. Adjust REC LEVEL control to a low level, such as –10 dB on the control panel vu meter.
7. Initiate the record mode.
8. Adjust BIAS potentiometer R71 (through the front of the PWA) for optimum bias.

NOTE

**The bias level must be monitored at test point TP2 of the PWA under test while a test recording is made. Record the tone supplied to CUE input at various levels of bias. Adjust bias level with potentiometer R71. Using a microphone, record verbal notes on an audio channel that indicate when the bias level is changed and what bias level is being used. Rewind tape to the beginning of the recording; play back the tape and note what bias level as monitored at TP2 results in the greatest output (as read on the vu meter). After the test tape has been played, and the proper bias level noted, initiate the record mode and while monitoring bias level at TP2, adjust potentiometer R71 to the bias level that resulted in the greatest output signal.**

**Record Level Adjustment.** Adjust record level as follows:

1. Set RECORD UNITY/VARIABLE toggle switch to UNITY.
2. Set audio input level to +8 dB or station's standard operating level.
3. Initiate record mode.
4. Adjust REC CAL potentiometer R37 (on front of PWA) for zero vu on the control panel vu meter.
5. Stop recorder.

**E-E Level Adjustment.** Adjust E-E level as follows:

1. Set jumper J13 to the A - D position.
2. Set jumper J10 to the A - C position.
3. Adjust potentiometer R3 for zero vu on the control panel vu meter.
4. Return jumpers J10 and J13 to normal operating position.

**Record Equalization Adjustment, 15 In/s.** Adjust 15-in/s equalization as follows:

1. Adjust the audio oscillator supplying audio signal to CUE INPUT for 1 kHz at –2 dBm.
2. Set the 15 IPS/7-½ IPS toggle switch on the capstan servo PWA to 15 IPS.

3. Set the RECORD UNITY/VARIABLE toggle switch to UNITY.

4. Initiate the record mode.

5. Record frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, 8 kHz, and 10 kHz.

6. Play back the tape and verify that all frequencies play back within ±2 dB of that measured for 1 kHz. If necessary adjust capacitor C10 as required to meet ±2 specification. On units extremely out of adjustment, it may be quicker to first record 400 Hz and 8 kHz and adjust capacitor C10 until those frequencies fall within specification.

**Record Equalization Adjustment, 7-½ In/S.** Adjust 7-½ in/s record equalization as follows:

1. Set the 15 IPS/7-½ IPS toggle switch on the capstan servo PWA to 7-½ IPS.

2. Set the RECORD/UNITY/VARIABLE toggle switch on the cue PWA to UNITY.

3. With audio oscillator supplying cue signal to CUE INPUT set for 1 kHz at –2 dBm, record frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, and 8 kHz.

4. Play back the tape and verify that all frequencies play back within ±2 dB of that measured for 1 kHz. If necessary, adjust capacitor C11 as required to meet ±2-dB specification. On units extremely out of adjustment, it may be quicker to first record 400 Hz and 5 kHz and adjust capacitor C11 until those frequencies fall within specification; then adjust C11 until all frequency specifications are met.

**Erase Current Adjustment.** Adjust erase current as follows:

1. Connect oscilloscope probe to TP3.

2. Initiate the record mode.

3. Adjust potentiometer R95 for 2.0 Vp-p (erasure will be to –42 dBm).

**Cue Tone Record Level Adjustment.** Adjust cue tone record level as follows:

1. Connect oscilloscope probe to TP6.

2. Jumper PWA pin 35/36 to ground.

3. Adjust potentiometer R87 for a 125-μs square wave (8.0 kHz).

4. Adjust potentiometer R41 for an output level of +8 dB above operating level.

5. Remove jumper from pin 35/36.

**Cue Notch Filter Adjustment.** Adjust cue notch filter as follows:

1. Adjust audio oscillator for +8 dBm at 240 Hz (250 Hz for 625-line systems).

2. Set jumper J9 to A - B position.

3. Adjust inductor L1 (located on the front panel trim to the left of PWA 1) for minimum output. The output should be no higher than –22 dBm.

4. Reinstall jumper J9 to the A - C position.

**Time Code Level Adjustment.** Adjust time code level as follows:

1. Connect an audio voltmeter to pins AA and BB of REMOTE connector J10 on the rear connector panel. Use balanced line terminated in 600 ohms at the voltmeter.

2. Record 1 kHz at +8 dBm.

3. Play back the recording and adjust potentiometer R154 for +11 dBm on the voltmeter.

## CONTROL LOGIC PWA 6, ASSEMBLY NO. 1373127

The control logic PWA, Assembly No. 1373269, requires no adjustments. Figure 3-22 is supplied as an aid to troubleshooting and Table 3-10 is a jumper list.

5. Place the recorder in the record mode.

6. Press the SETUP pushbutton on the front of the editor PWA 7.

7. Adjust the ERASE DELAY potentiometer on the front of editor PWA 7 so that the envelope of head no. 4 at the beginning of the rf level display is at full level, and the next 15 envelopes (heads 2, 3, 1 and 4 in that order) are completely erased. See Figures 3-25 and 3-26.

## SYNC GENERATOR PWA 30, ASSEMBLY NO. 1373083

A block diagram of the Sync Generator PWA, Assembly No. 1373083, is provided in Figure 3-27. Table 3-11 provides the jumper list for PWA 30. Align the sync generator as follows:

1. Perform *Power Supply Regulator Adjustment* procedure given previously under *System Power.*

2. Set GEN LOCK/INT REF toggle switch on front of sync generator PWA 30 to GEN LOCK.

3. Place sync generator PWA 30 on an extender board.

4. Place jumper J1 in A - B position.

5. Place jumper J2 in A - B position (crystal VCO).

6. Connect oscilloscope probe to junction of resistor R100 and resistor R136.

7. Using a non-magnetic screwdriver, adjust inductor L6 for zero volts dc ±100 mV.

8. Place jumper J2 in B - C position

9. Connect oscilloscope probe to junction of integrated circuit A17-6, collector of transistor Q14 and resistor R137.

10. Adjust inductor L7 for zero volts dc ±100 mV.

11. Place jumpers J1 and J2 for desired operation.

12. Remove jumper J13 (Figure 3-28).

13. Connect oscilloscope channel 1 probe to PWA 30 pin 15/16 (video input). Trigger scope from PWA pin 75, V drive.

14. Connect oscilloscope channel 2 probe to PWA 30 pin 55/56 (comp sync out).

15. Adjust HORIZ PHASE control on front panel of sync generator PWA for leading edge of H sync of video in signal to be coincident with leading edge of H sync of comp sync out signal.

16. Connect oscilloscope channel 2 probe to junction of integrated circuit pins A38-1; A29-3,4; and A31-5. Trigger scope from PWA 30 pin 75.

17. Adjust potentiometer R151 for pulse at channel 2 to be in center of last broad pulse of vertical interval of video input (channel 1). See Figure 3-29/A.

18. Verify that video input (PWA 30 pin 15/16) and sync out (PWA 30 pin 55/56) are coincident in the horizontal and vertical interval.

19. Replace jumper J13.

20. Remove oscilloscope probes from the PWA.

21. Connect oscilloscope probe to E5.

22. Adjust inductor L2 for peak 3.58-MHz burst.

23. Remove oscilloscope probe from E5.

24. Connect oscilloscope probe to E9.

25. Adjust inductor L8 for zero volts dc ±100 mV.

26. Remove oscilloscope probe from E9.

27. Connect oscilloscope channel 1 probe to PWA 30 pins 83/84 (subcarrier out).

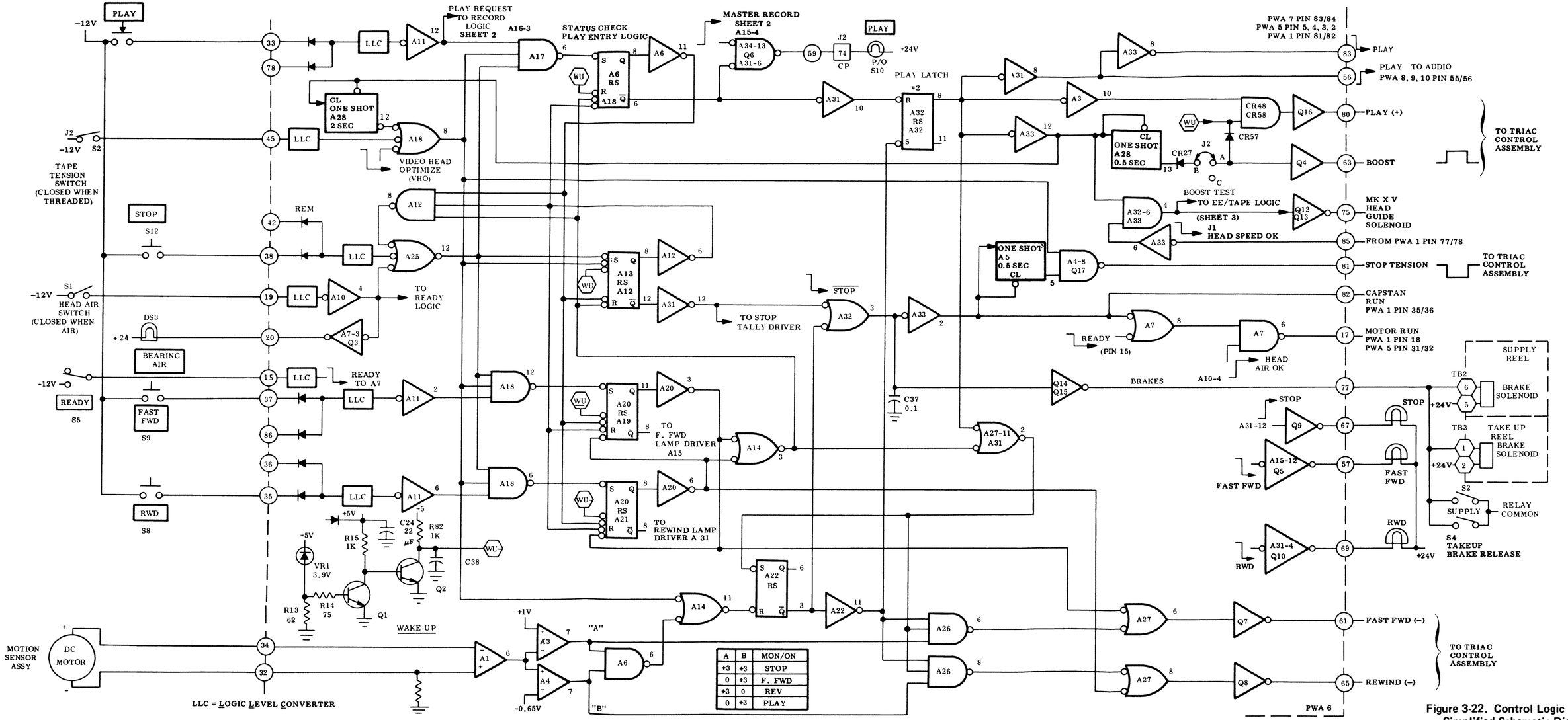



Figure 3-22. Control Logic PWA, Simplified Schematic Diagram (Sheet 1 of 3)

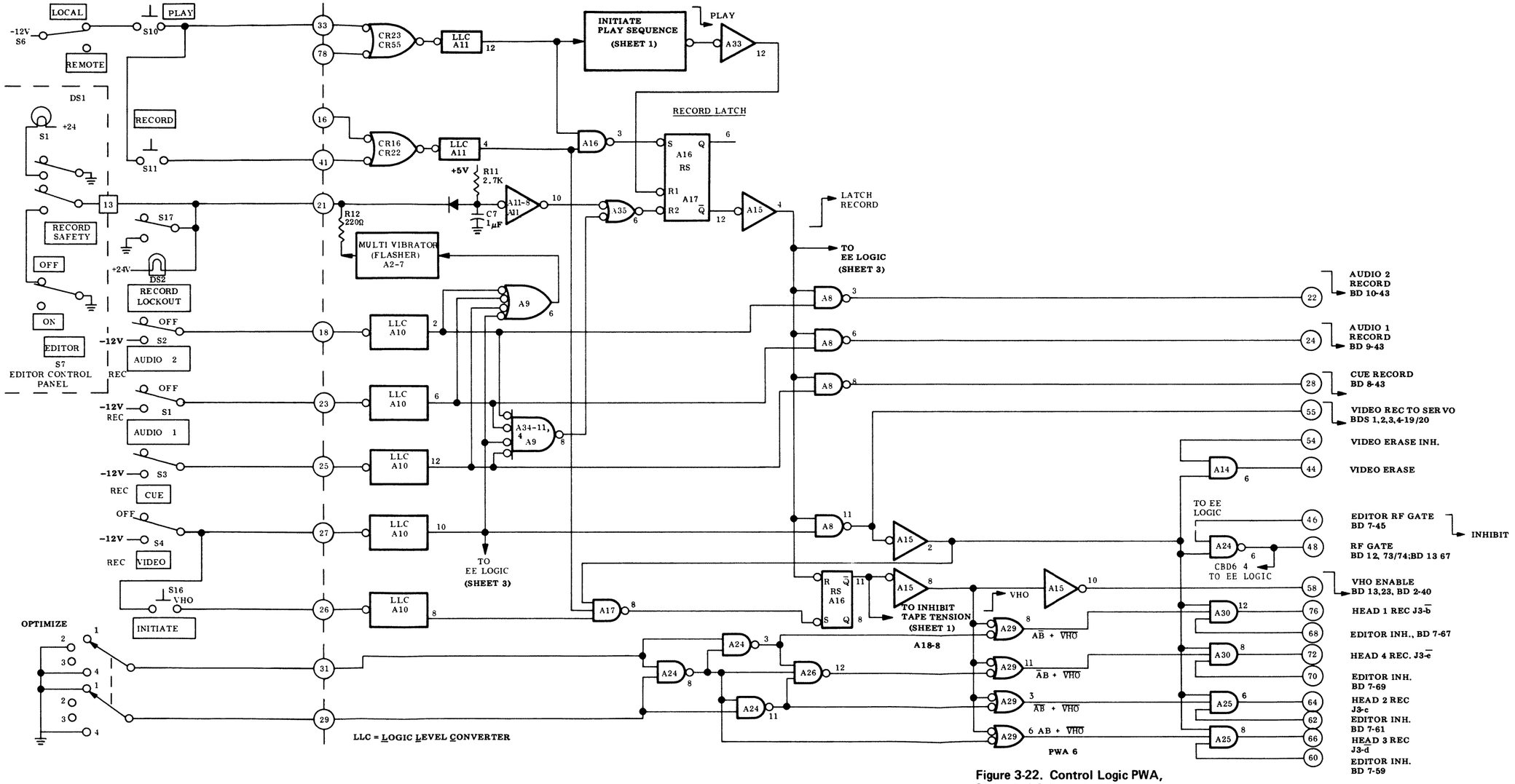



**Figure 3-22. Control Logic PWA, Simplified Schematic Diagram (Sheet 2 of 3)**

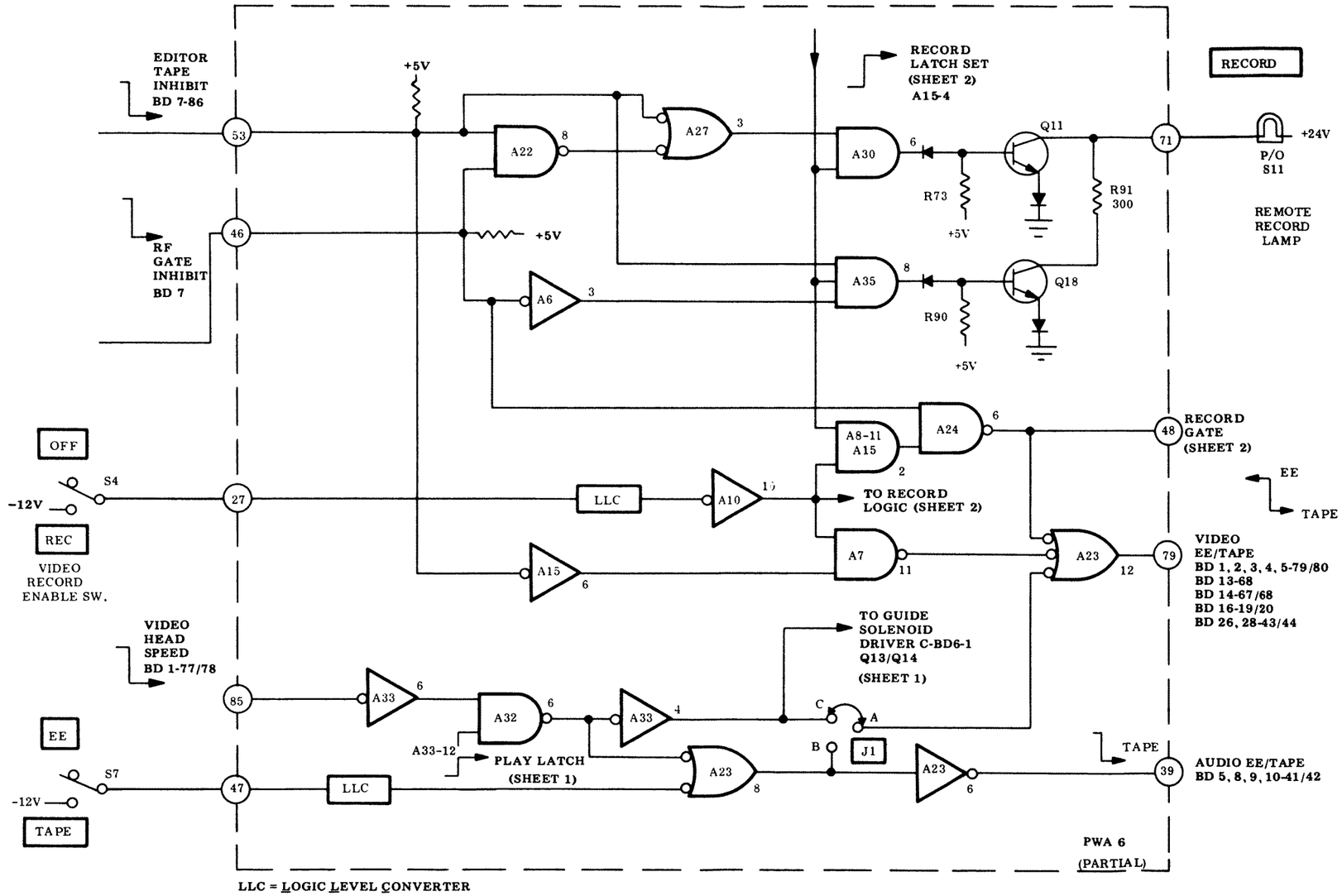



**Figure 3-22. Control Logic PWA, Simplified Schematic Diagram (Sheet 3 of 3)**

Table 3-10. Jumper List, Control Logic PWA 6, Assembly No. 1373127

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | Video E-E/tape command corresponds to E-E tape switch position. |
| | A - C | Holds video command in the E-E mode until the video headwheel comes up to speed, then switches to tape. |
| J2 | A - B | Normal. |
| | A - C | Constant boost command to the control triac. |

## EDITOR PWA 7, ASSEMBLY NO. 1373127

A block diagram of the Editor PWA, Assembly No. 1373127, is provided in Figure 3-23. Align the editor PWA as shown in the following procedures.

### Playback Cue Tone Delay

1. Place editor PWA 7 on an extender.
2. Turn system power off.
3. Connect ohmmeter between PWA pin 20 (entrance shift control) and pin 9/10 (+5-volt bus).
4. Adjust ENTRANCE SHIFT control on the editor control panel to the electrical center as read on ohmmeter.
5. Loosen setscrew securing ENTRANCE SHIFT control knob to shaft of potentiometer.
6. Set pointer of control knob to zero and secure knob to potentiometer shaft with setscrew.
7. Connect ohmmeter between PWA pin 19 (exit shift control) and pin 9/10 (+5 volt bus).
8. Adjust EXIT SHIFT control on the editor control panel to its electrical center as read on ohmmeter.
9. Loosen setscrew securing EXIT SHIFT control knob to shaft of potentiometer.
10. Set pointer of control knob to zero and secure knob to potentiometer shaft with setscrew.
11. Remove ohmmeter.
12. Turn on system power.
13. Connect oscilloscope probe to pin 2 of A17.
14. Adjust potentiometer R45 (see Figure 3-24) for a time between pulses of 9.4 ms.
15. Connect oscilloscope probe to pin 2 of A40.
16. Adjust potentiometer R46 for a time between pulses of 9.4 ms.

### Cue Tone Playback Level Set

1. Connect channel A of oscilloscope to pin 6 of A18.
2. Connect channel B of oscilloscope to pin 7 of A18.
3. Record cue tones at the rate of three tones per second every other second for two minutes.
4. Set EDITOR toggle switch on control panel to ON.
5. Play back the recorded cue tones.
6. Adjust potentiometer R37 so that reference level at pin 7 of A18 is midway between the average cue tone level and the average noise level at pin 6 of A18.
7. Verify that the EDIT CMD lamp flashes three times per second every other second as recorded; if not, readjust potentiometer R37. There should be no missing or extra pulses.

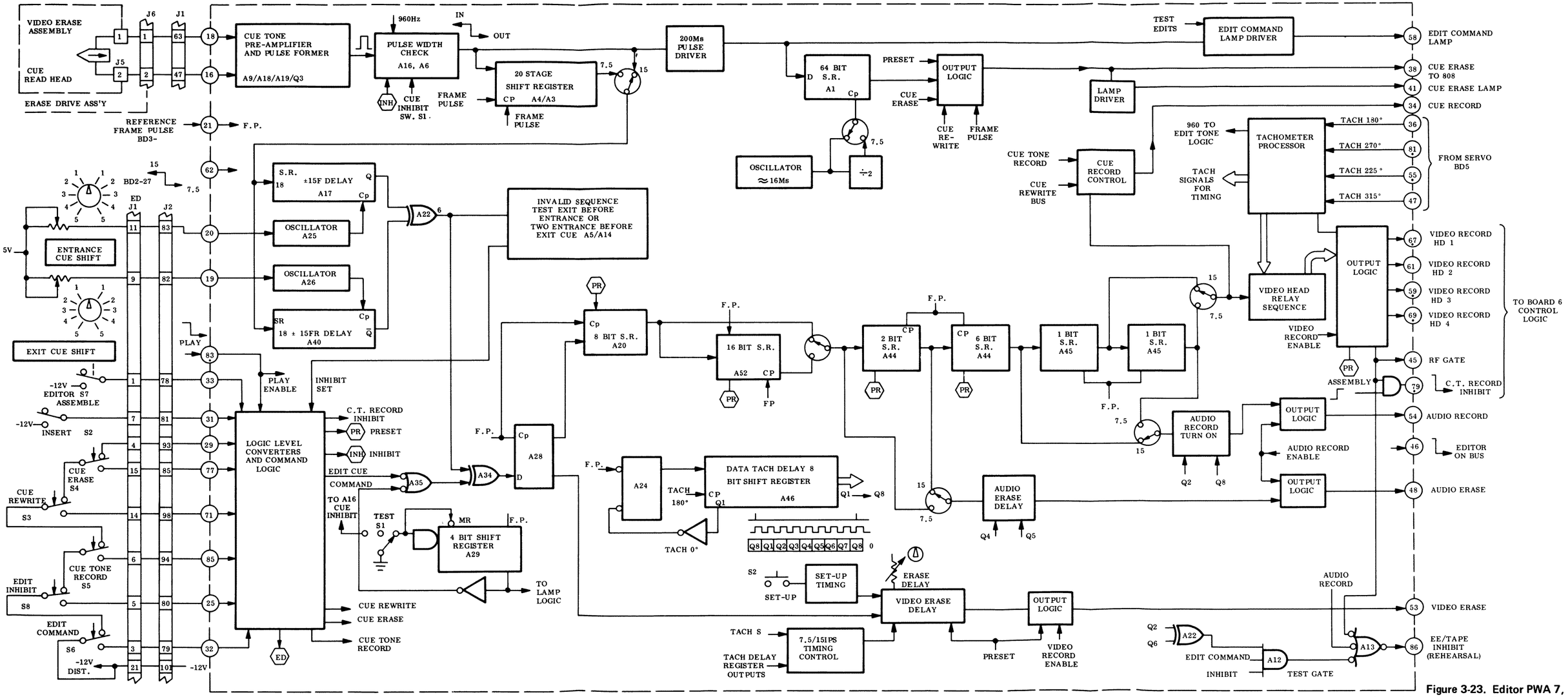



**Figure 3-23. Editor PWA 7, Assembly No. 1373127 Block Diagram**

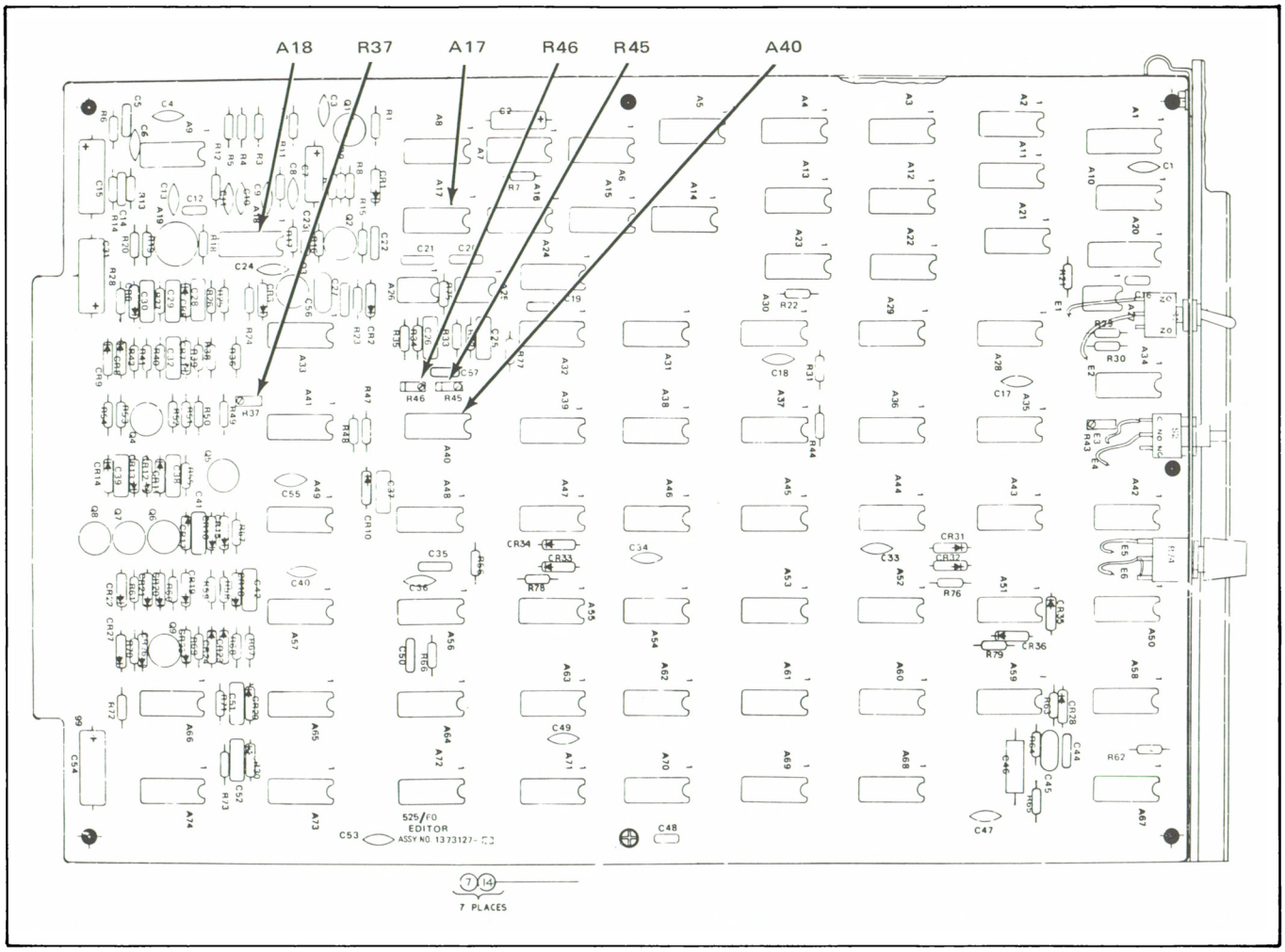



**Figure 3-24. Editor PWA, Module No. 7, Assembly No. 1373127**

### Cue Tone Erase Gate

1. Select CUE on the monitor control panel.
2. Play back the cue tones recorded in step 2 of the *Cue Tone Playback Level Set* procedure given previously.
3. Increase the volume level.
4. Adjust potentiometer R43 clockwise until tones can be heard; then adjust potentiometer R43 counterclockwise until tones can be heard. Finally, adjust R43 halfway between the points where the cue tones were heard; this will be a point where the EDIT CMD lamp lights but no cue tones are heard on the monitor.

### Erase Delay

1. Make a recording approximately five minutes long, then rewind to the beginning.
2. Set VIDEO toggle switch on the control panel to REC.
3. Set the INSERT/ASSEMBLE toggle switch on the editor control panel to ASSEMBLE.
4. Select RF LEVEL on the monitor control panel.

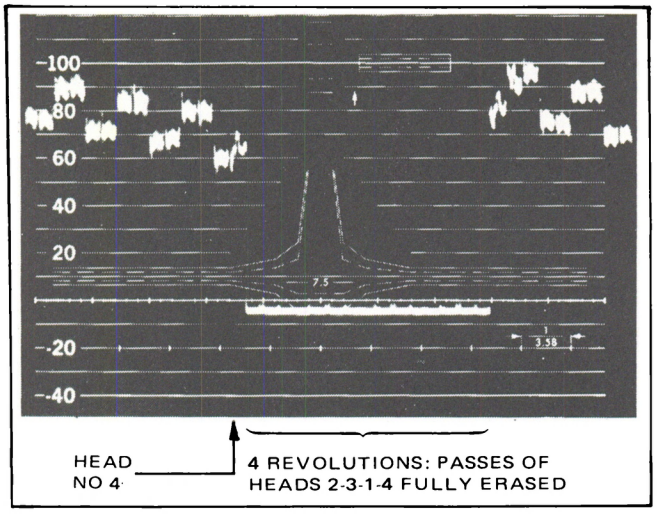



Figure 3-25. Correct Erase Point

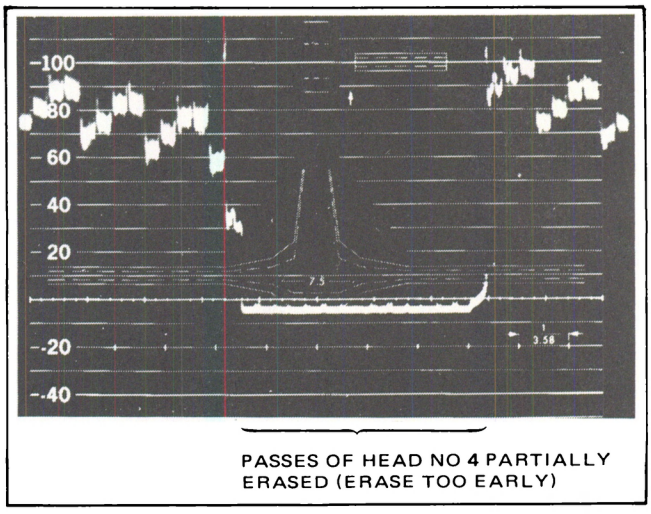
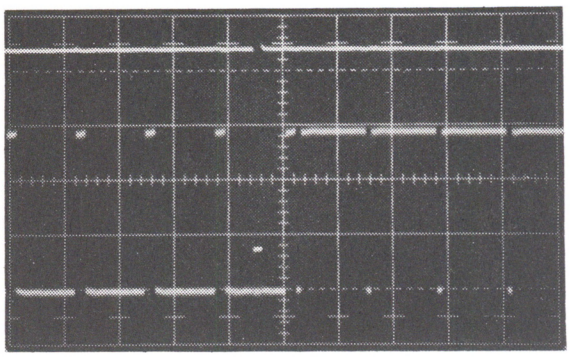



Figure 3-26. Incorrect Erase Point

Table 3-11. Jumper List, Sync Generator PWA 30, Assembly No. 1373083

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | B - C | AUTO SEL – used only if the stable oscillator accessory is installed. Uses stable oscillator when S1 on Internal Reference or there is no video input. |
| | A - B | EXT REF – when stable oscillator accessory not installed. Oscillator used depends on position of J2. |
| J2 | A - B | NORMAL – crystal-controlled (XTAL VCO). |
| | B - C | Wide-range sync-lock function (LC VCO). |
| J3 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 17 of field 1. |
| J4 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 18 of field 1. |
| J5 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 19 of field 1. |
| J6 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 20 of field 1. |
| J7 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 21 of field 1. |
| J8 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 17 of field 2. |
| J9 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 18 of field 2. |
| J10 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 19 of field 2. |
| J11 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 20 of field 2. |
| J12 | Removed | NORMAL – jumper removed. |
| | A - B | Unblank line 21 of field 2. |
| J13 | A - B | NORMAL |
| | B - C | Inhibits sync-delay control. |



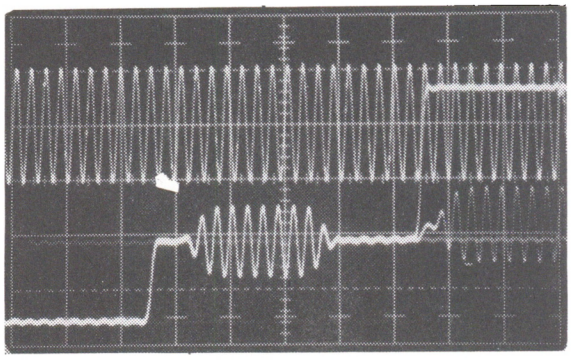
A

CHANNEL 2 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | A38-1 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | PWA PIN 75 |
| SWEEP RATE: | 50 μS/CM, DELAYED, X2 MAGNIFIER |

CHANNEL 1 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 15/16 |
| VERTICAL SENSITIVITY: | 0.01V/CM |
| PROBE: | X10 |



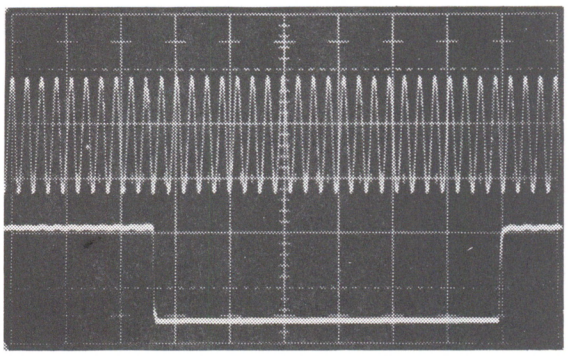
B

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 83/84 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | PWA PIN 71 |
| SWEEP RATE: | 1 μS/CM, X2 MAGNIFIER, DELAYED |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 15/16 |
| VERTICAL SENSITIVITY: | 0.02V/CM |
| PROBE: | X10 |



C

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 83/84 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | PWA PIN 72 |
| SWEEP RATE: | 1 μS/CM, DELAYED |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 71/72 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |

Figure 3-29. Alignment Waveforms, Sync Generator (NTSC) PWA 30, Assembly No. 1373083

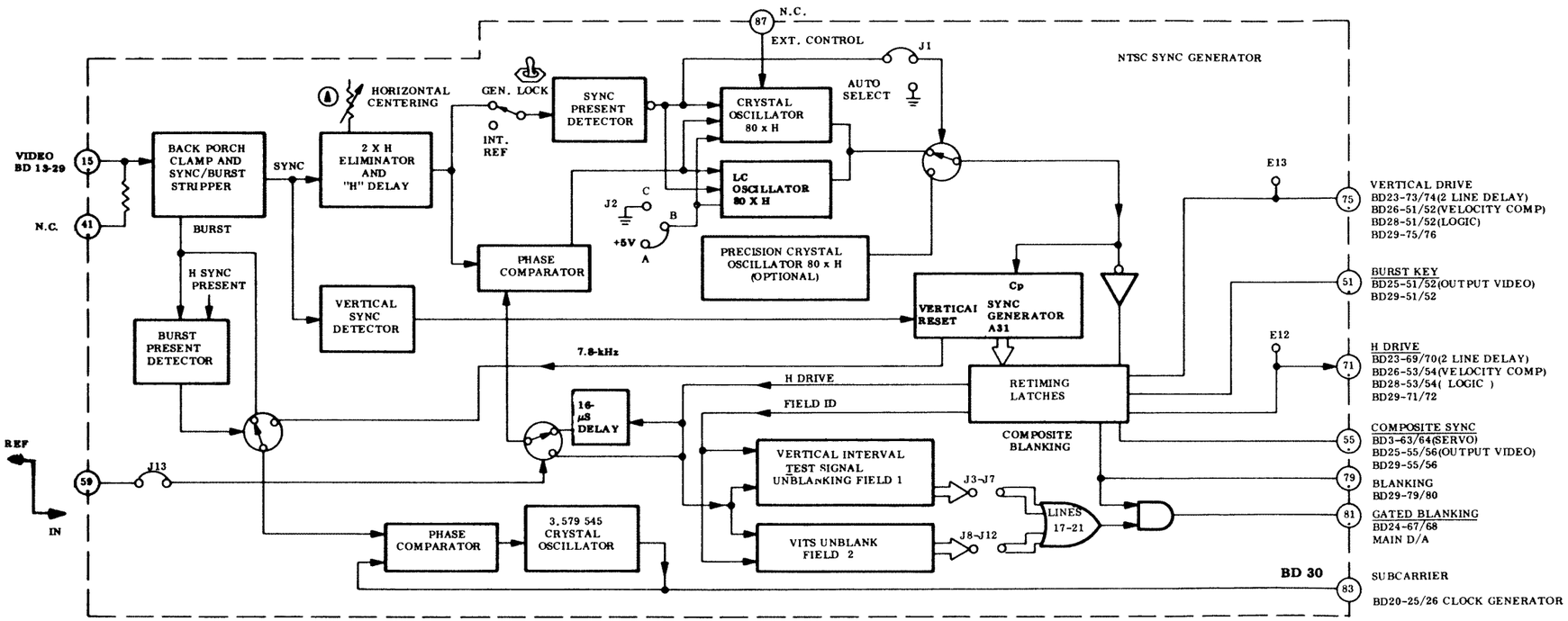



**Figure 3-27. Sync Generator (NTSC)**
**PWA 30, Assembly No. 1373083**
**Block Diagram**

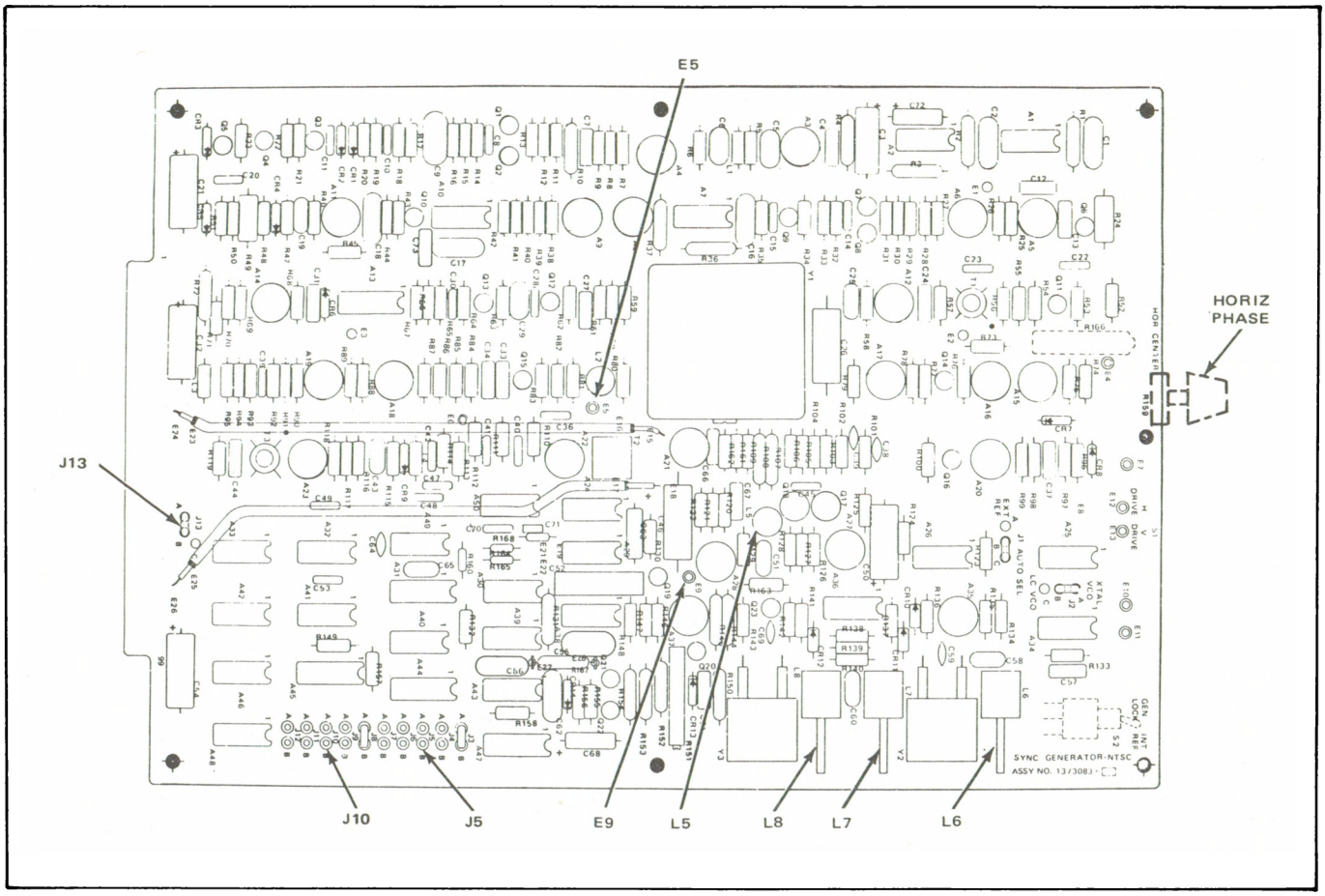



**Figure 3-28. Sync Generator (NTSC) PWA 30, Assembly No. 1373083**

28. Adjust inductor L5 for maximum amplitude of the subcarrier.

29. Connect oscilloscope channel 2 probe to PWA 30 pins 15/16 (video input). Trigger scope from PWA pin 71 (H drive).

30. Verify subcarrier out signal (channel 1) is locked to video input (channel 2). For locking, subcarriers must be stable relative to each other; phase may differ. See Figure 3-29/B.

31. Connect oscilloscope channel 2 probe to PWA 30 pins 71/72.

32. Verify subcarrier (channel 1) is locked to H-drive (channel 2). See Figure 3-29/C.

## SERVO SYSTEM

The following paragraphs contain the checkout and alignment procedures for ensuring proper operation of the servo system. These procedures have been performed at the factory and need be repeated only when a repaired or replacement PWA has been installed in the recorder or when the recorder has otherwise become misadjusted. Figure 3-30 is a block diagram showing the interrelationships of the PWA used in the capstan servo system. A functional block diagram of the capstan servo system is given in Figure 3-31. Figure 3-32 is a block diagram showing the interrelationships of the PWA used in the headwheel servo system. A functional block diagram of the headwheel servo system is given in Figure 3-33.

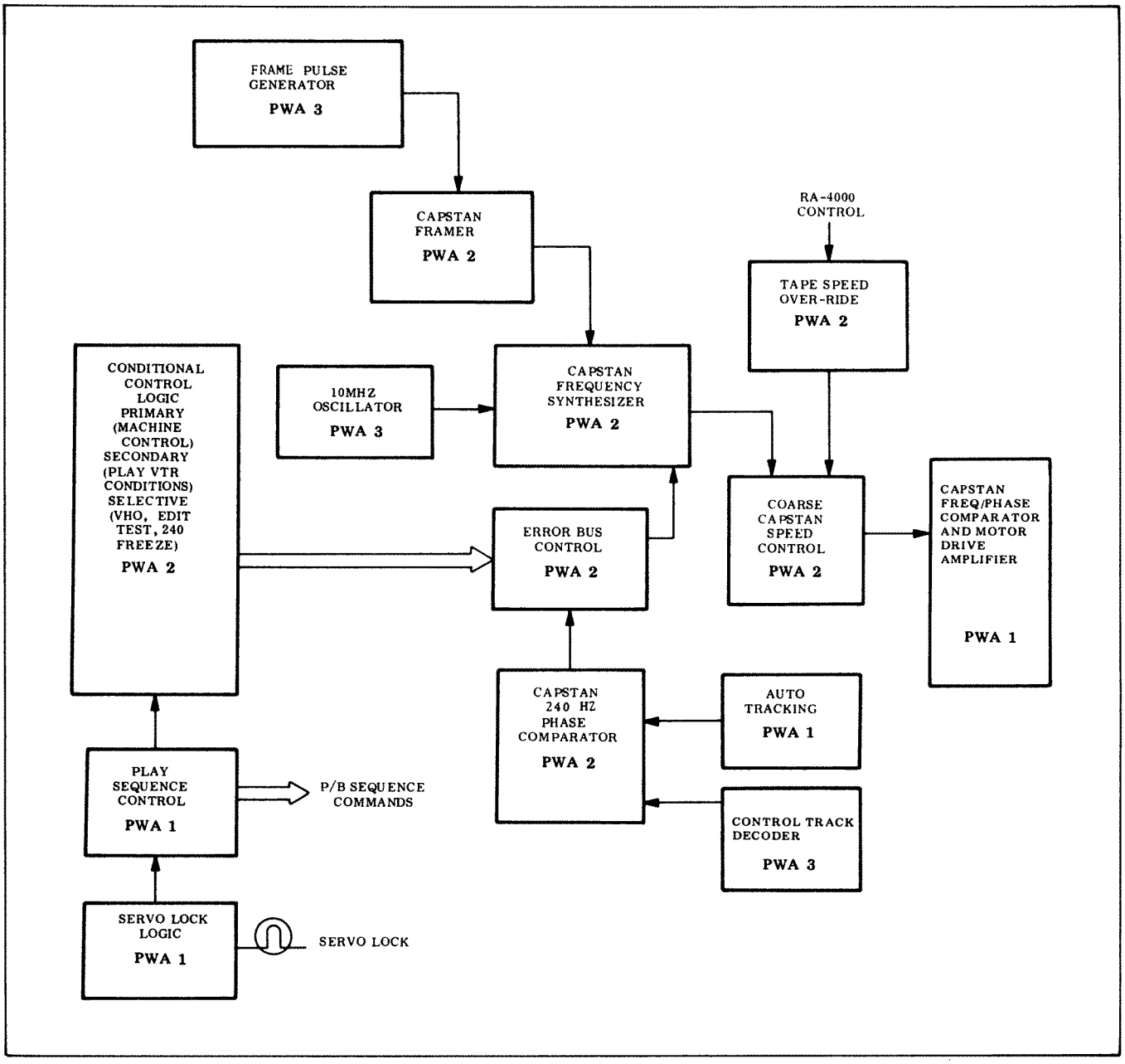
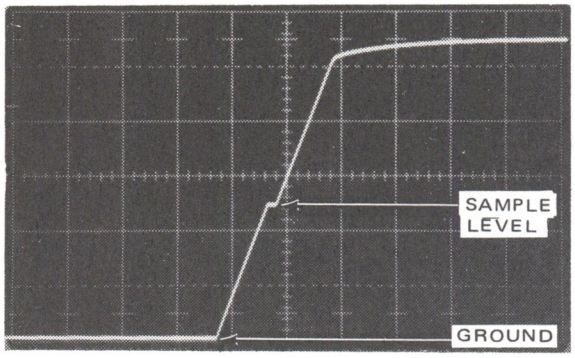



**Figure 3-30. Capstan Servo System Block Diagram**

### Head Driver PWA 5, Assembly No. 137016

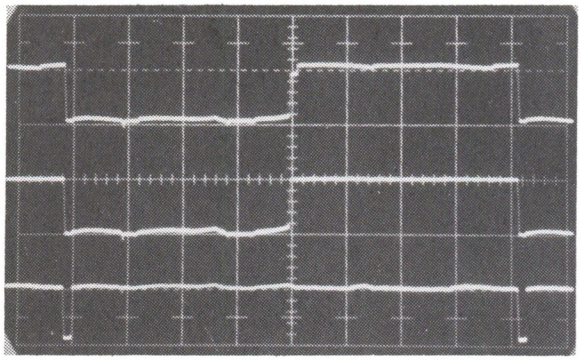
The jumpers on the head driver PWA and their normal positions are given in Table 3-12. Align the Head Driver PWA 5, Assembly No. 1373016, as follows:

1. Place the head driver PWA 5 on an extender.
2. Set the READY toggle switch on the control panel to ON.
3. Connect oscilloscope probe to junction of A48 pin 3, R26, R27 and R28 (see Figure 3-34).
4. Adjust potentiometer R1 slowly for +2.5V ±100 mV; this setting determines where ramp is sampled (see Figure 3-35).



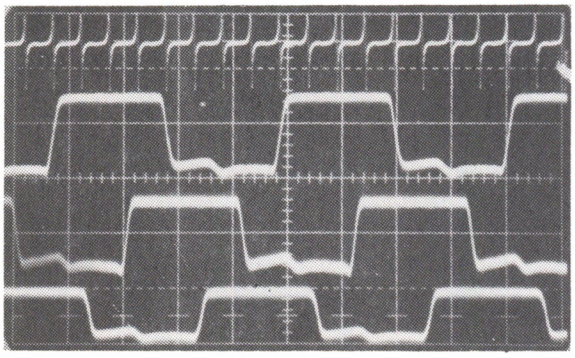

A

| | |
|---|---|
| TEST POINT: | E6 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X 10 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 100 μS/CM |



B

| | |
|---|---|
| UPPER WAVEFORM TEST POINT: | PIN 69 |
| MIDDLE WAVEFORM TEST POINT: | PIN 71 |
| LOWER WAVEFORM TEST POINT: | PIN 72 |
| VERTICAL SENSITIVITY: | 1V/CM |
| PROBE: | X 10 |
| TRIGGER: | PIN 25 |
| SWEEP RATE: | 500 μS/CM |



C

| | |
|---|---|
| TOP WAVEFORM TEST POINT: | PIN 39 |
| SECOND WAVEFORM TEST POINT: | PIN 75 |
| THIRD WAVEFORM TEST POINT: | PIN 77 |
| BOTTOM WAVEFORM TEST POINT: | PIN 78 |
| VERTICAL SENSITIVITY: | 0.01V/CM EXCEPT TOP WAVEFORM 0.5V/CM |
| PROBE: | X 10 |
| TRIGGER: | PIN 25 |
| SWEEP RATE: | 1 MS/CM |

Figure 3-35. Troubleshooting Waveforms, Head Driver PWA 5, Assembly No. 1373171

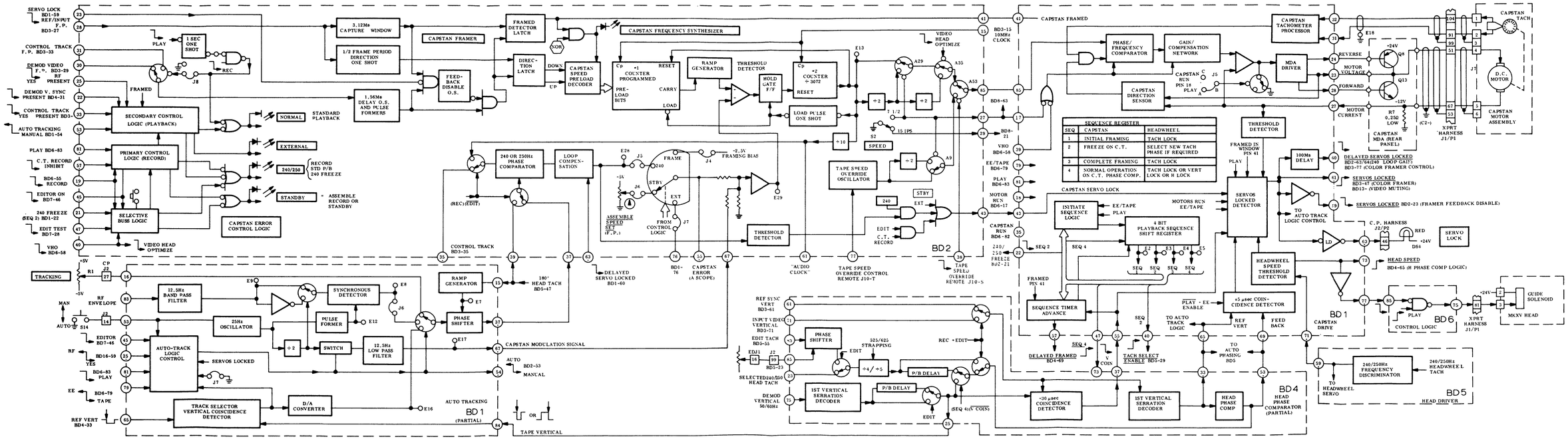



**Figure 3-31. Capstan Servo System Functional Block Diagram**

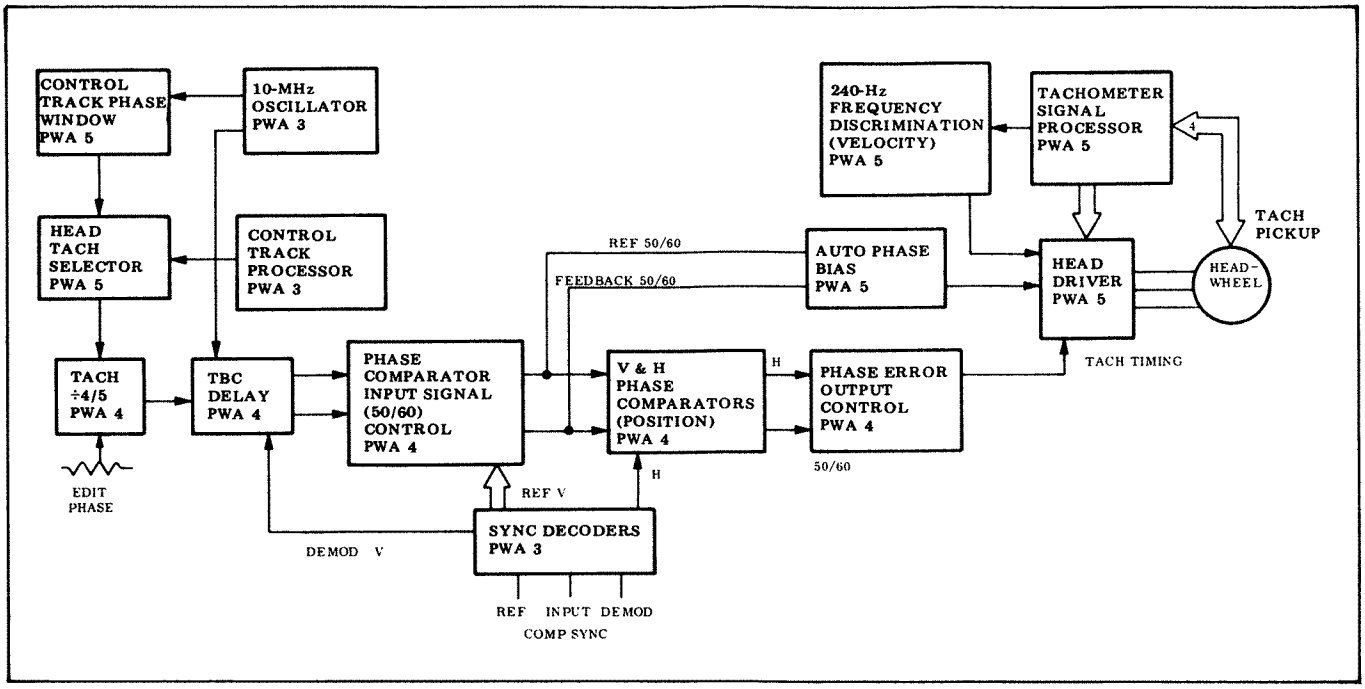



**Figure 3-32. Headwheel Servo System Simplified Block Diagram**

**Table 3-12. Jumper List, Head Driver PWA, Assembly No. 1373016**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| | | J1, J2 and J5 used together for up/down counter test. |
| J1* | B to C | NORMAL |
| | A to B | Test-Use with J2 and J5 for test of count up/down circuit. |
| J2* | A to B | NORMAL |
| | B to C | Test-Use with J1 and J5. |
| J3 | A to B | NORMAL |
| | B to C | Test - Presets count for approximately 2.5V. |
| J4 | A to B | NORMAL |
| | B to C | Test - Freezed count. |
| J5* | A to B | NORMAL |
| | B to C | Test - Use with J1 and J2. |
| J6 | A to B | NORMAL |
| | Remove | Test - Enables counter, counts continuously. |
| J7 | A to B | NORMAL |
| | Remove | Defeats auto phasing. |
| J8 | A to B | NORMAL |
| | Remove | Defeats phase comparator. |
| J9 | A to B | NORMAL |
| | B to C | Test - Defeats frequency disc (fixes voltage to head drivers). |

| *Countdown test setup: | | Countup test setup: | |
|---|---|---|---|
| J1 | B to C | J1 | A to B |
| J2 | B to C | J2 | A to B |
| J5 | B to C | J5 | Remove |

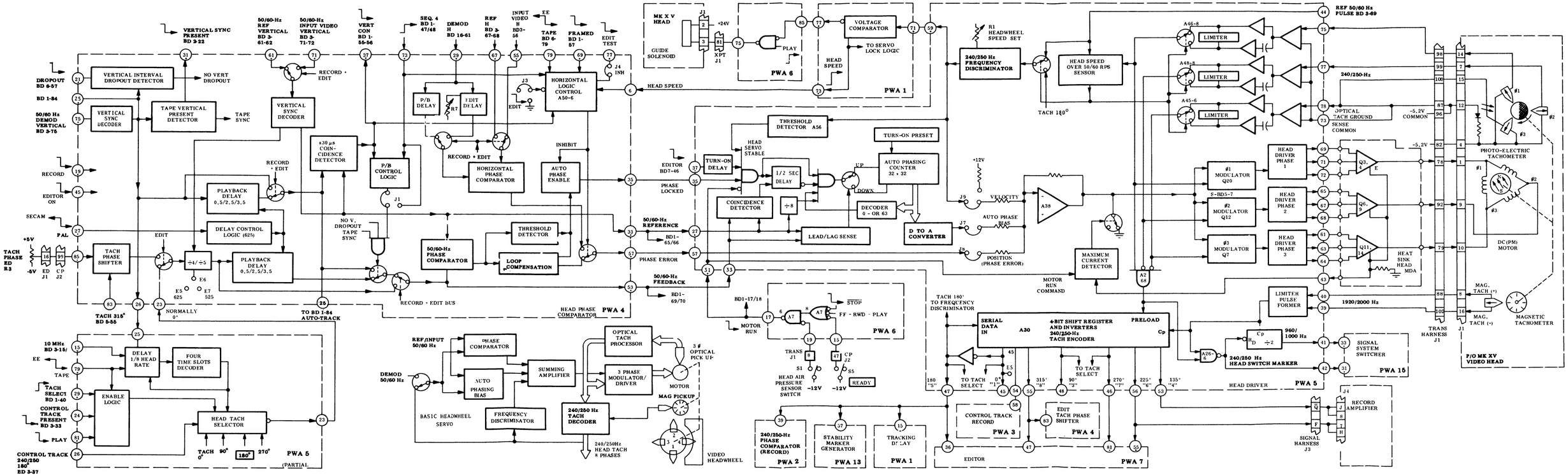



Figure 3-33. Headwheel Servo System Functional Block Diagram

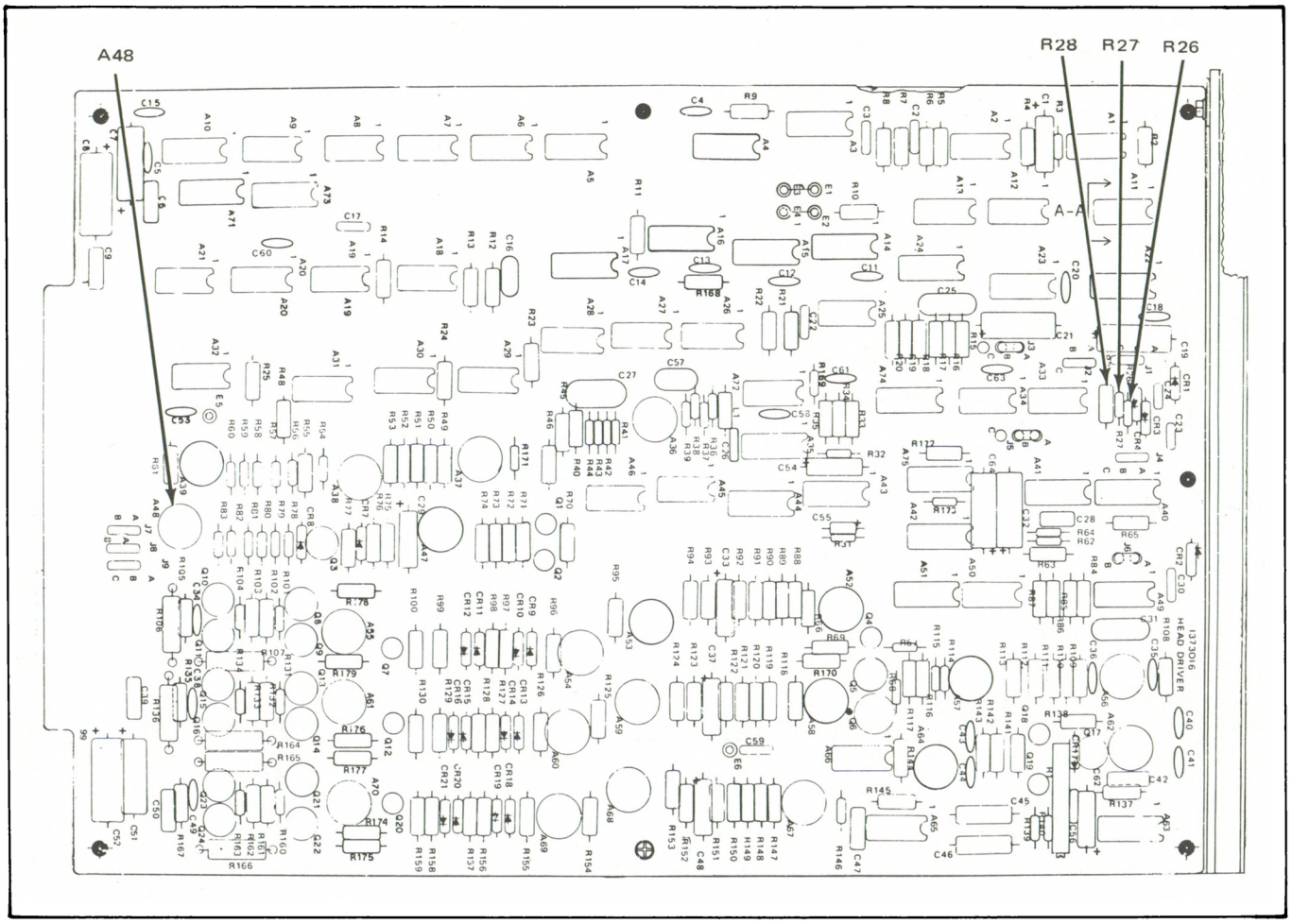



Figure 3-34. Head Driver PWA, Assembly No. 1373016

## Head Phase Comparator PWA 4, Assembly No. 1373171

**NOTE**

**The following adjustments are required only if an editor PWA is installed in the AVR-2.**

The jumpers on the head phase comparator PWA are listed in Table 3-13. Align the Head Phase Comparator PWA 4, Assembly No. 1373171, as follows:

1. Place the head phase comparator PWA on an extender.
2. Trigger the oscilloscope from pin 55/56 (input H) and observe pin 29/30 (demod H). Set sweep speed for 100 ns/cm.
3. Make a short recording. Adjust the scope to place the negative edge of demod H three centimeters to the left of center.
4. Rewind the tape, turn on the editor, and play back the recording.
5. Adjust potentiometer R7 (see Figure 3-36) so that the playback demod H occurs 350 ns later than its record position. Average out the instability of the demod H pulse; instability is normally 50 ns p-p (see Figure 3-37). Figure 3-37 is a double exposure showing demod H during record (upper waveform) and demod H during playback (lower waveform).

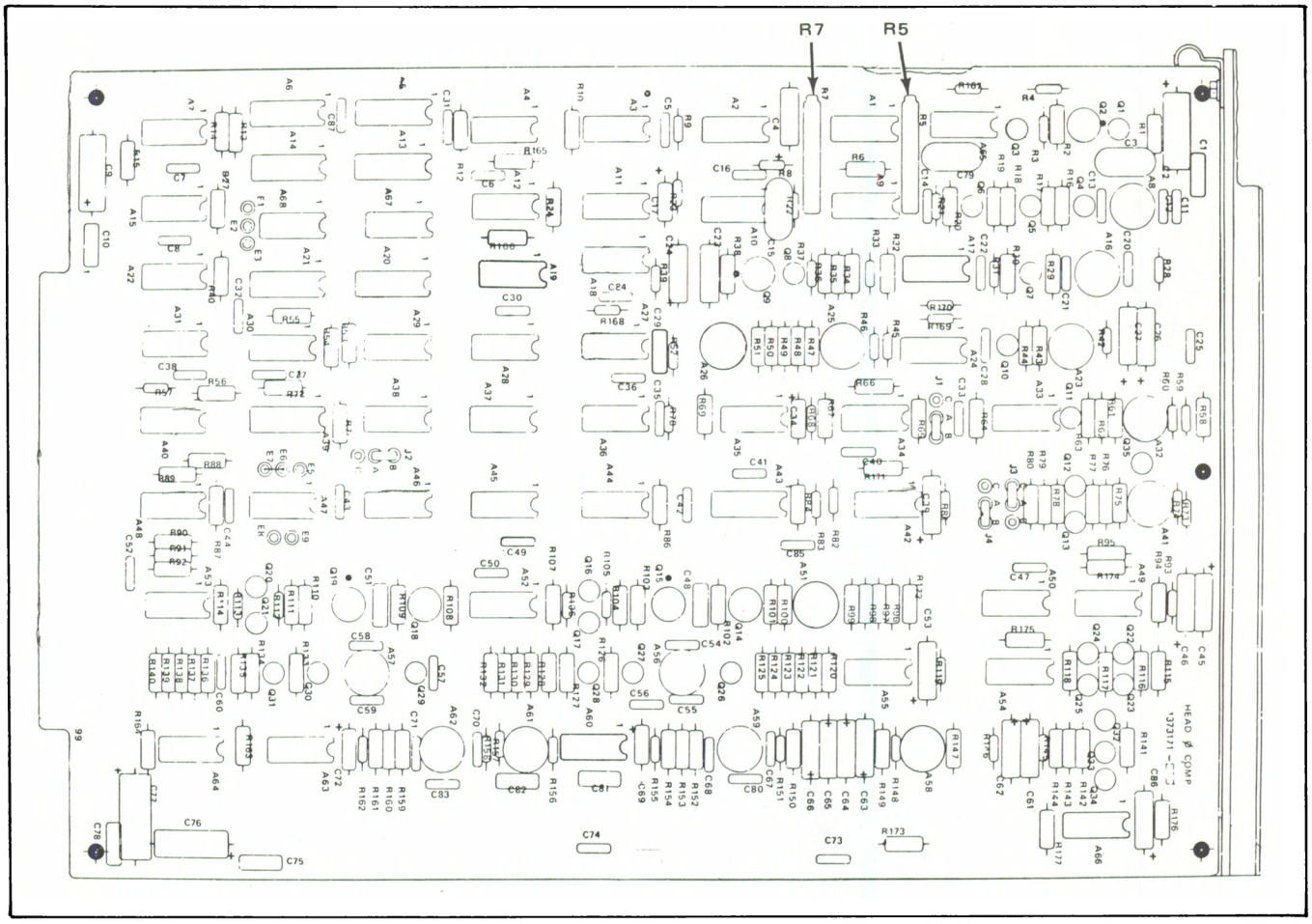
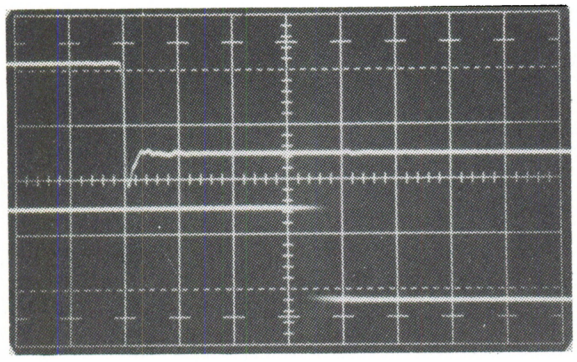



Figure 3-36. Head Phase Comparator PWA 4, Assembly No. 1373171



| | |
|---|---|
| UPPER WAVEFORM | |
| TEST POINT: | PIN 30 (RECORD MODE) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |
| TRIGGER: | PIN 55 |
| SWEEP RATE: | 100 NS/CM |
| LOWER WAVEFORM | |
| TEST POINT: | PIN 30 (PLAYBACK MODE) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |

Figure 3-37. Alignment Waveform, Head Phase Comparator PWA 4, Assembly No. 1373171

6. Adjust TACH PHASE control on the editor control panel to the center of its range.

7. Select DEMOD on the monitor panel.

8. With the editor on, play back the recording made in step 3. During playback press EDIT CMD and adjust potentiometer R5 so that the leading edge of blanking of the inserted (input) video is coincident with the leading edge of blanking of the playback (demod) video. Average out the playback video instability.

**NOTE**

**Potentiometer R5 has a range greater then ±2 lines; therefore, verify that the SERVO LOCK lamp on the control panel is extinguished when final adjustment is reached. It may be necessary to continue adjusting potentiometer R5 for another area where the horizintal interval lines up.**

### Capstan Servo PWA 2 Assembly No. 1373150

Table 3-14 lists the jumpers on the capstan servo

**Table 3-13. Jumper List, Head Phase Comparator PWA 4, Assembly No. 1373171**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A to B | NORMAL |
| | B to C | Forces vertical lock. |
| | Removed | Forces tach lock. |
| J2 | A to B | NORMAL – Input "V" in record, Reference "V" in play. |
| | A to C | Selects reference "V" in record. |
| J3 | A to C | NORMAL – "H" lock in edit play only. |
| | A to B | Selects "H" lock in all play modes. |
| | Removed | Defeats "H" lock. |
| J4 | A to B | NORMAL – disables "H" lock in edit test. |
| | A to C | Defeats "H" lock. |
| | Removed | Enables "H" lock in edit test. |

**Table 3-14. Jumper List, Capstan Servo PWA 2, Assembly No. 1373150**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| | | J7, J2 and J3 used for testing up/down counter. |
| J1* | A to B | NORMAL |
| | B to C | Test – Used with J2 and J3 for countdown. |
| J2* | A to B | NORMAL |
| | B to C | Test – Freezes counter. |
| | Removed | Test – Enables counter use with J1 and J3. |
| J3* | A to B | NORMAL |
| | B to C | Test – Forces counter to countdown. |
| | Removed | Test – Use with J1 and J2. |
| J4 | A to B | NORMAL |
| | Removed | Defeats framing bias. |
| J5 | A to B | NORMAL |
| | Removed | Defeats capstan error. |
| J6 | A to B | NORMAL |
| | Removed | Defeats standby bias and assemble speed set. |
| J7 | A to B | NORMAL |
| | Removed | Defeats external control. |
| J8 | A to B | NORMAL |
| | B to C | Forces CT frame pulse reference. |
| | Removed | Forces Demod frame reference pulse. |

| *Countdown test setup: | | Countup test setup: | |
|---|---|---|---|
| J1 | Remove | J1 | B to C |
| J2 | Remove | J2 | Remove |
| J3 | B to C | J3 | Remove |

PWA. Align the Capstan Servo PWA 2, Assembly No. 1373150, as follows:

1. Make a test recording for about two minutes.
2. Place capstan servo PWA 2 on an extender and connect oscilloscope probe to PWA pin 31/32 (CT frame).
3. Trigger oscilloscope from pin 28 (input/ reference frame).
4. Jumper pin 77/78 (TSO control) to ground.
5. Play back the recording and adjust potentiometer R52 for a stationary waveform (see Figure 3-38).
6. Remove oscilloscope from pin 31/32.
7. Remove grounding jumper from pin 77/78.
8. Connect oscilloscope probe to pin 31/32 (CT frame).
9. Trigger oscilloscope from pin 28 (input/ reference frame).
10. Play back a recording that is to have an assemble edit added.
11. While recording is playing back, press the PUSH TO SET button on front of PWA 2 and adjust the ASSEMBLE SPEED SET potentiometer (R118) for a stationary waveform.

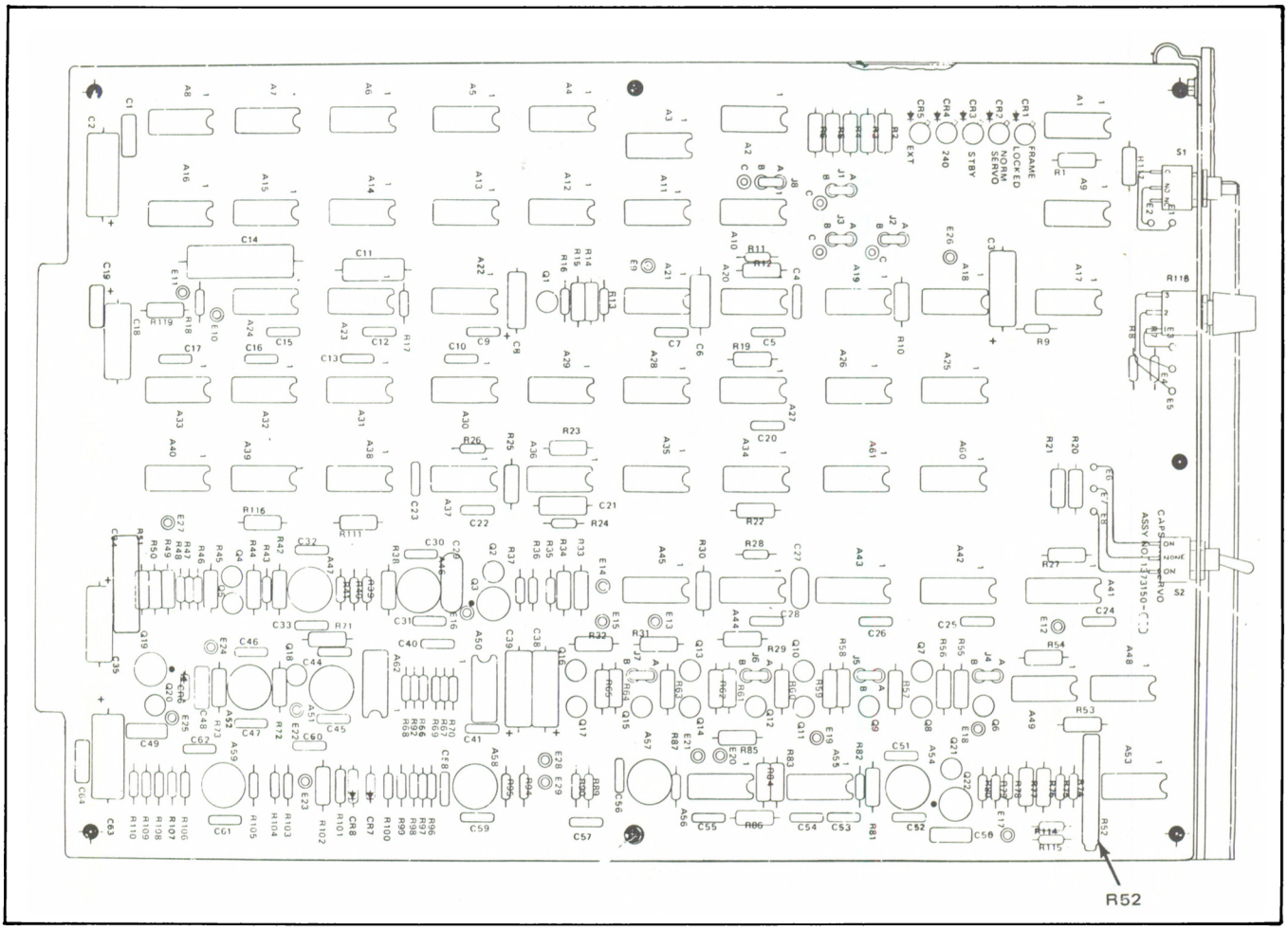



**Figure 3-38. Capstan Servo PWA 2, Assembly No. 1373150**

12. See AVR-2 Operator's manual (Catalog No. 1809177) for further instructions.

**Control Track and Sync Processor PWA 3, Assembly No. 1373168**

Align Control Track and Sync Processor PWA 3, Assembly No. 1373168, as follows:

1. Place the control track and sync processor PWA on an extender.
2. Connect oscilloscope probe to E3 (see Figure 3-39).
3. Trigger oscilloscope from pin 55 (input frame).
4. Put recorder in record mode.
5. Adjust potentiometer R67 to place frame pulse in the center of the positive half cycle of the sine wave, as shown in Figure 3-40.
6. Select CTL TRACK on the monitor control panel.
7. With recorder in record mode, adjust CT REC LEVEL control on the front of the PWA until the waveform begins to distort.

NOTE

**Zero crossover should be at a 30° to 45°angle. The correct appearance of the control track waveform during playback is shown in Figure 3-41.**

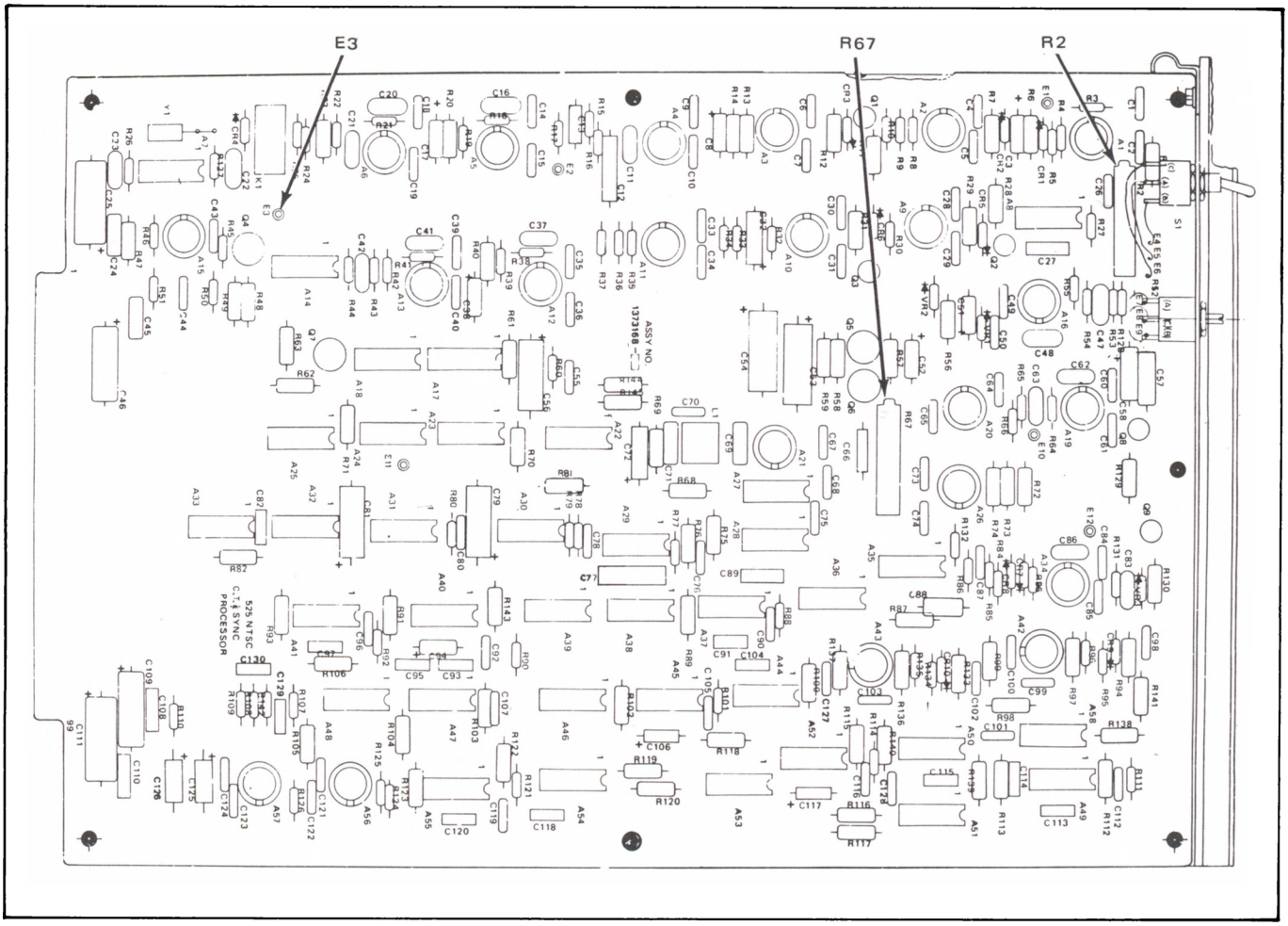



**Figure 3-39. Control Track and Sync Processor PWA 3, Assembly No. 1373168**

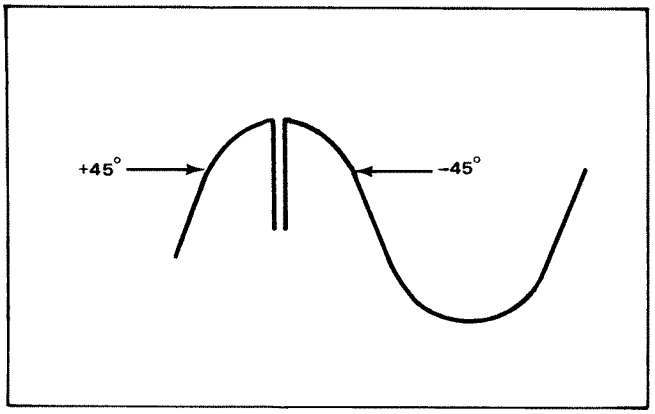



**Figure 3-40. Frame Pulse**

8. Record a test signal for two minutes.

9. Connect channel 1 probe of oscilloscope to pin 47 (head tach 180) of the head driver PWA (PWA 5).

10. Connect channel 2 probe of scope to pin 26 of head driver PWA 5 (control track 240 @ 180°).

11. Adjust control track delay potentiometer R2 (see Figure 3-39) on the control track and sync processor PWA so that the negative edge of control track 240 @ 180° is coincident with the positive edge of head tach 180°.

**Manual Tracking and Capstan Drive PWA 1, Assembly No. 1373112**

Table 3-15 is a jumper list for the manual tracking and capstan drive PWA. Align Manual Tracking and Capstan Drive PWA 1, Assembly No. 1373112, as follows:

1. Record a test signal for about two minutes.

2. Play back the recording.

3. Adjust the TRACKING control on the control panel to the center of its excursion.

4. Adjust potentiometer R13 (see Figure 3-42) for maximum tracking indication on tracking meter on control panel.

**Auto Tracking and Capstan Drive PWA 1, Assembly No. 1373298**

Table 3-16 is a jumper list for the auto tracking and capstan drive PWA. Align the Auto Tracking and Capstan Drive PWA, Assembly No. 1373298, as follows:

1. Mount the auto tracking PWA on an extender and install the extender into the number 1 slot in the electronics rack.

2. Turn on the system power.

3. Thread tape on the recorder.

4. Make a one-minute recording.

5. Play back the recording.

6. Pull TRACKING knob on the recorder's control panel outward to place system in the manual tracking mode.

7. Set the TRACKING potentiometer to the center of its range.

8. Adjust potentiometer R147 on the PWA (see Figure 3-43) for peak indication on the TRACKING meter. Note the value of the peak reading.

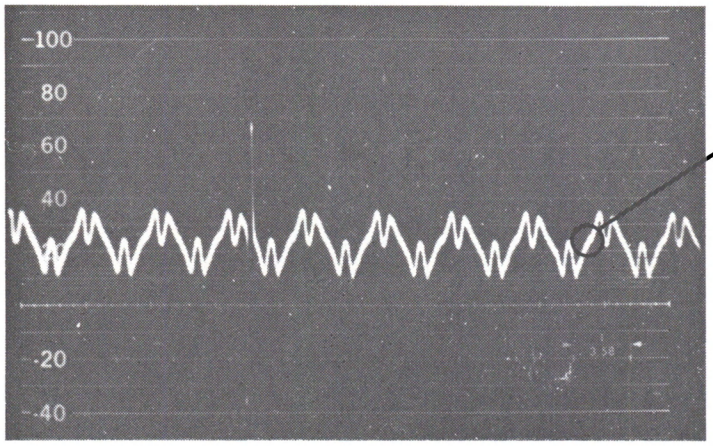
9. Place jumper J7 on the PWA to the B - C position.

10. Connect a scope probe to tie lug E8 of the PWA.

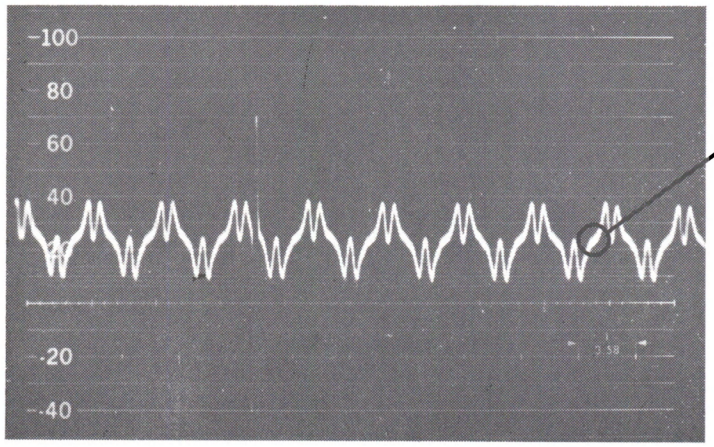
11. Adjust the TRACKING potentiometer for an approximate 15% decrease in the meter reading from the value noted in step 8.

12. Observe the scope. The 12.5-Hz signal shown in Figure 3-44 will be observed. Note that the signal's polarity may be the reverse of that shown in Figure 3-44 as polarity is affected by the position of the TRACKING potentiometer.

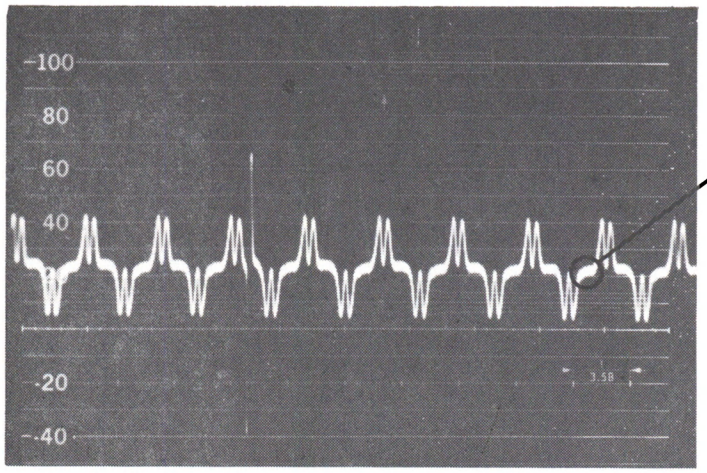
13. Adjust potentiometer R204 on the PWA for the smallest discontinuity present in the lower waveform of Figure 3-44. This will indicate when the detector output is on frequency. Waveforms resulting from incorrect adjustment of R204 are shown in Figure 3-45.




LOW LEVEL




CORRECT LEVEL




HIGH LEVEL

**Figure 3-41. Control Track Waveforms**

Table 3-15. Jumper List, Manual Tracking and Capstan Drive PWA 1, Assembly No. 1373112.

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A to B | NORMAL - Capstan follows either play or MTR run command. |
| | B to C | Capstan follows MTR run command. |
| J2 | A to B | NORMAL |
| | B to C | Forces register to sequence selected by J3. |
| J3 | A to E | NORMAL |
| | B to E | Register remains in sequence 2. |
| | C to E | Register remains in sequence 3. |
| | D to E | Register remains in sequence 4. |
| J5 | A to B | NORMAL |
| | Removed | Disables Capstan Error to Capstan MDA. |

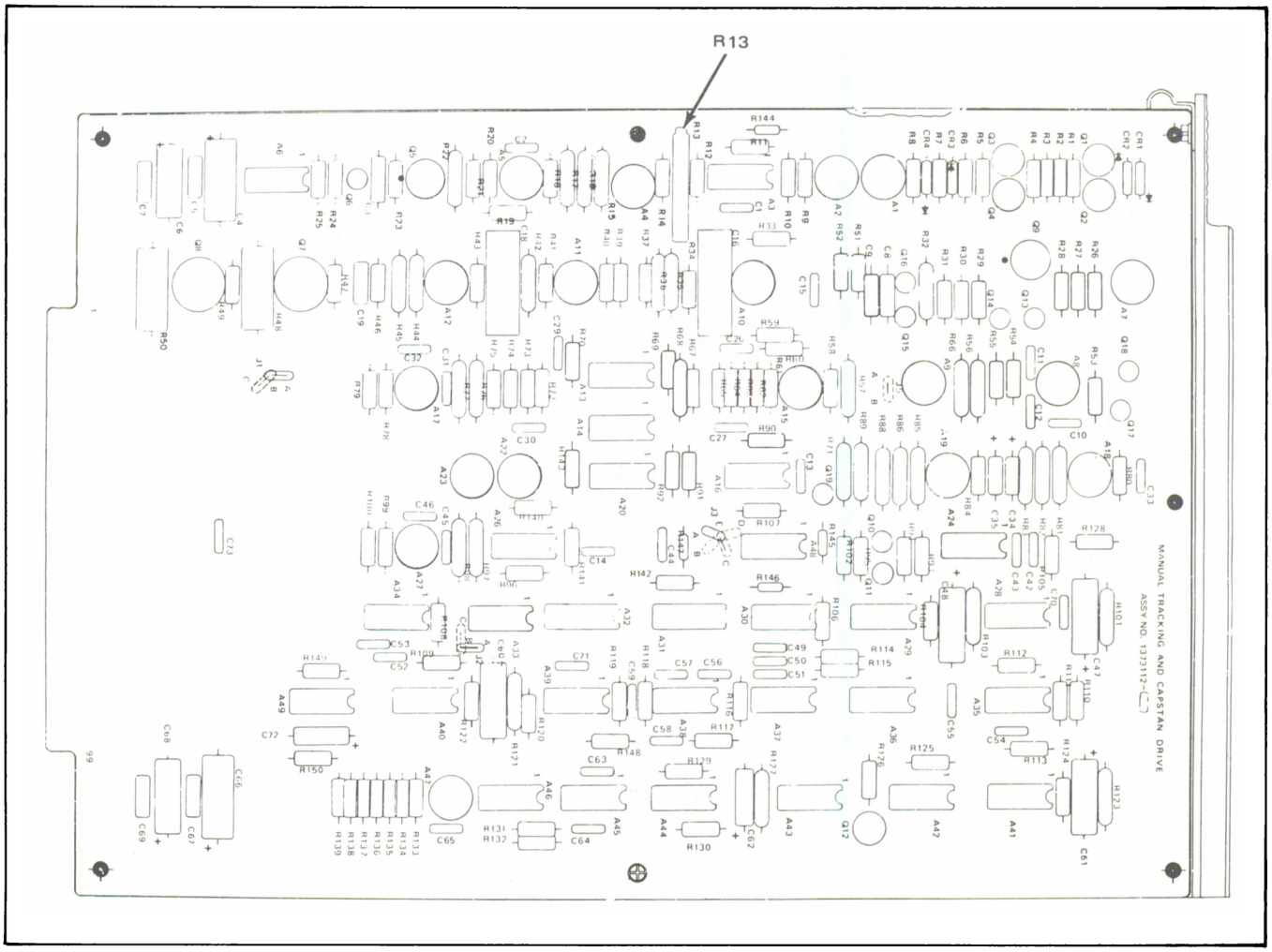



Figure 3-42. Manual Tracking and Capstan Drive PWA 1, Assembly No. 1373112

Table 3-16. Jumper List, Auto Tracking and Capstan Drive Assembly No. 1373298

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A to B | NORMAL |
| | Removed | Remove to measure capstan servo bandwidth. |
| J2 | Removed | Not used. |
| J3 | A to E | NORMAL; register in normal sequence. |
| | B to E | Remains in sequence; used in conjunction with J4. |
| | C to E | Remains in sequence 3; used in conjunction with J4. |
| | D to E | Remains in sequence 4; used in conjunction with J4. |
| J4 | A to B | NORMAL |
| | B to C | Forces register to any sequence selected by J3. |
| J5 | A to B | NORMAL; capstan motor runs on Play command. |
| | B to C | Capstan motor runs on Motors Run command. |
| J6 | A to B | NORMAL |
| | Removed | Remove to measure auto tracking servo loop bandwith. |
| J7 | A to B | NORMAL |
| | B to C | Dithers capstan in manual mode for tracking setup. |

14. Rock the TRACKING potentiometer alternately clockwise and counterclockwise. The polarity of the waveform at E8 should alternate as the potentiometer rotates alternately clockwise and counterclockwise.
15. Replace jumper J7 to the A - B (normal) position.
16. Adjust TRACKING control for peak indication on the TRACKING meter and note reading.
17. Adjust TRACKING control for meter reading of approximately 15% less than that noted in step 17.
18. Push TRACKING knob inward to place system in auto tracking mode. Meter indication will return to peak.
19. Turn system power off. Remove extender from machine and install PWA in machine.

## VIDEO SIGNAL SYSTEM

The following paragraphs contain the checkout and alignment procedures for ensuring proper operation of the video signal system. These procedures have been performed at the factory and need be repeated only when a repaired or replacement PWA has been installed in the recorder or when the recorder has otherwise become misadjusted. A block diagram of the video signal system is given in Figure 3-46. Figures 3-47 and 3-48 provide more detailed block diagrams of the video signal system in record and playback.

### Modulator PWA 12, Assembly No. 1373147

**CAUTION**

**THE FOLLOWING PROCEDURES ARE NOT TO BE ROUTINELY PERFORMED. THE ADJUSTMENTS CALLED FOR ARE PERFORMED AT THE FACTORY AT THE TIME OF THE PWA's MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD UNLESS THE NEED FOR IT IS CERTAIN AND THE REQUIRED TEST EQUIPMENT IS ACQUIRED.**

See Table 3-17 for a jumper list for the modulator PWA and Figure 3-49 for component locations.

**Modulator Frequency and Deviation Adjustment.** Adjust the modulator frequency and deviation as follows:

1. Connect an unmodulated stairstep signal to the VIDEO IN connector on the rear connector panel. Verify that the signal has the proper sync and video level.

**NOTE**

**Verify calibration of spectrum analyzer with a sweep generator and a frequency counter before using.**

2. Connect spectrum analyzer to PWA pin 69/70.

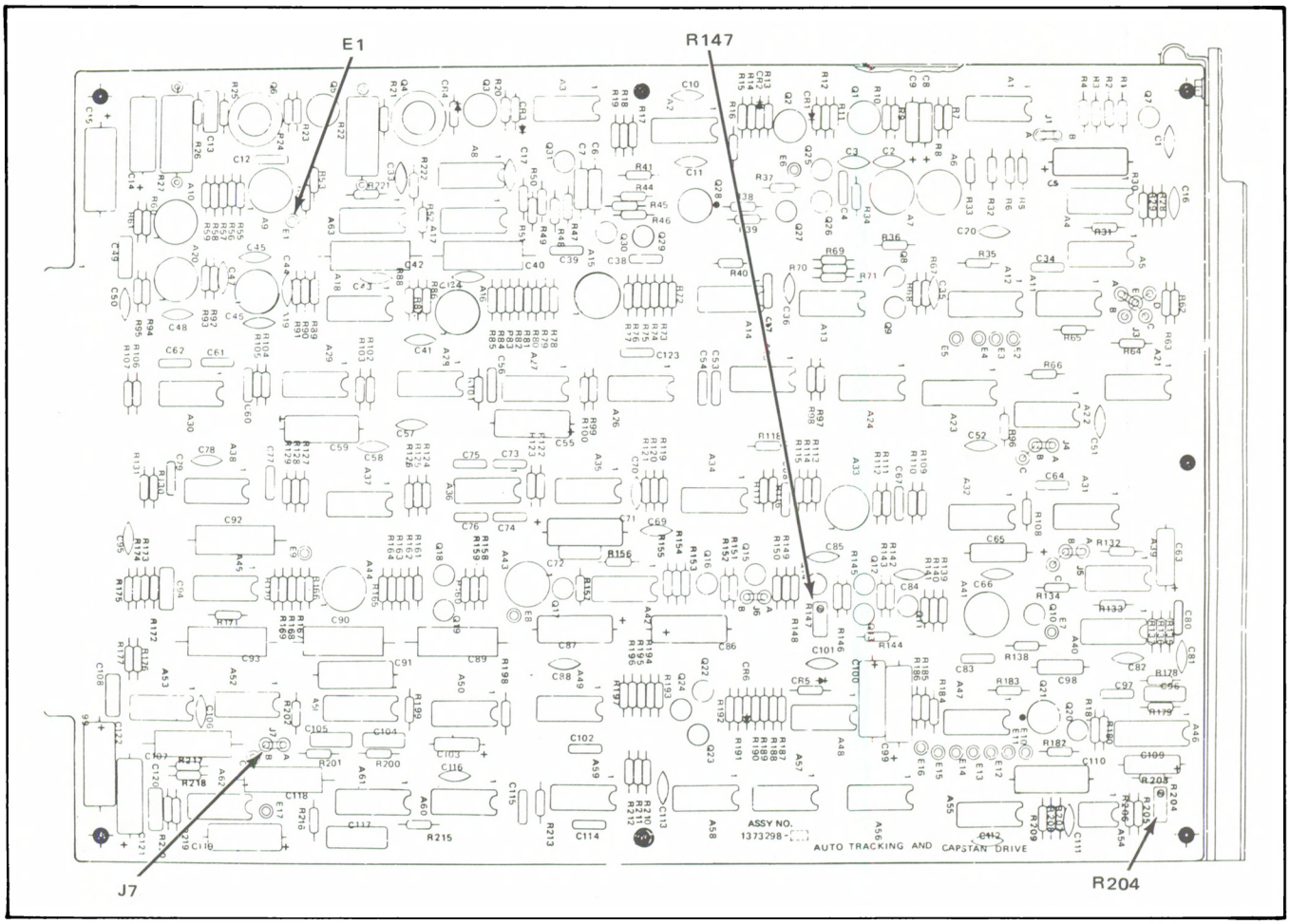
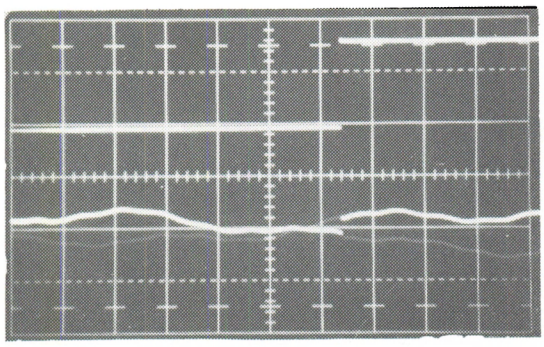
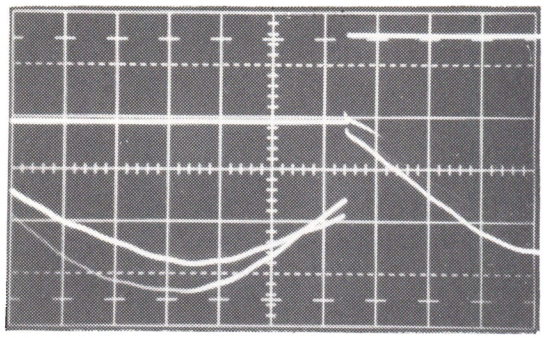



**Figure 3-43. Auto Tracking and Capstan Drive PWA 1, Assembly No. 1373298**



| | |
|---|---|
| CHANNEL 1 (UPPER WAVEFORM) | |
| TEST POINT: | + SIDE OF CAPACITOR C119 |
| VERTICAL SENSITIVITY: | 2V/CM |
| PROBE: | X 10 |
| TRIGGER: | CHANNEL 1 |
| SWEEP RATE: | 5 MV/CM |
| CHANNEL 2 (LOWER WAVEFORM) | |
| TEST FORM: | E8 |
| VERTICAL SENSITIVITY: | 0.5V/CM |
| PROBE: | X 10 |

**Figure 3-44. Auto Tracking Adjustment Waveforms, Correct Adjustment**



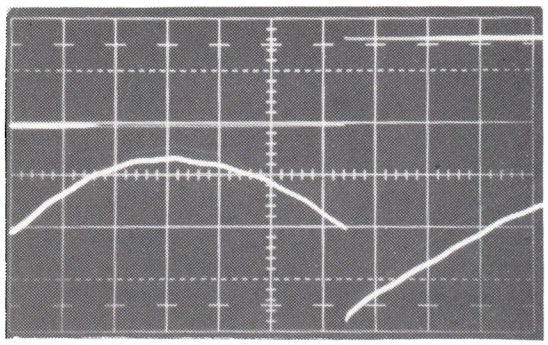
A

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | + SIDE OF CAPACITOR C119 |
| VERTICAL SENSITIVITY: | 2V/CM |
| PROBE: | X10 |
| TRIGGER: | CHANNEL 1 |
| SWEEP RATE: | 5 MV/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E8 |
| VERTICAL SENSITIVITY: | 0.5V/CM |
| PROBE: | X10 |



B

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | + SIDE OF CAPACITOR C119 |
| VERTICAL SENSITIVITY: | 2V/CM |
| PROBE: | X10 |
| TRIGGER: | CHANNEL 1 |
| SWEEP RATE: | 5 MV/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E8 |
| VERTICAL SENSITIVITY: | 0.5V/CM |
| PROBE: | X10 |

**Figure 3-45. Auto Tracking Adjustment Waveforms, Incorrect Adjustment**

3. Adjust potentiometer R65 for a blanking frequency of 7.90 ±0.05 MHz.

4. Adjust potentiometer R56 for a peak white frequency of 10 ±0.10 MHz.

**Differential Phase and Differential Gain.** Adjust differential phase and differential gain as follows:

1. Supply a modulated ramp signal to the VIDEO IN connector on the rear connector panel.

2. Connect a vectorscope to the VIDEO OUT MONITOR connector on the rear connector panel.

3. Press DEMOD OUT button on the monitor panel.

4. Adjust capacitor C55 for the best differential gain. Differential gain should be less than 0.5%.

5. Adjust potentiometer R97 for the best differential phase. Differential phase should be less than 0.5%.

6. Repeat steps 4 and 5 several times because there is a slight interaction between R97 and C55.

**Frequency Response.** Adjust the frequency response of the modulator as follows:

1. Supply a sweep frequency of the VIDEO IN connector on the rear connector panel.

2. Adjust inductor L2 for the flattest response at 4.5 MHz (flat within 0.20 dB).

### Demodulator PWA 16, Assembly No. 1373058

**CAUTION**

**THE FOLLOWING PROCEDURES ARE NOT TO BE ROUTINELY PERFORMED. THE ADJUSTMENTS CALLED FOR ARE PERFORMED AT THE FACTORY AT THE TIME OF THE PWA's MANUFACTURING AND SHOULD NOT BE PERFORMED IN THE FIELD UNLESS THE NEED FOR IT IS CERTAIN AND THE REQUIRED TEST EQUIPMENT IS ACQUIRED.**

See Table 3-18 for a jumper list for the demodulator or PWA and Figure 3-50 for component locations.

**Video Level Adjustment and Meter Calibration.** Adjust the video level and calibrate the meter as follows:

1. Ensure that the modulator PWA is properly adjusted.
2. Supply an unmodulated stairstep test signal at the VIDEO INPUT connector on the rear connector panel.
3. Connect an oscilloscope probe to PWA pin 81/82.
4. Adjust potentiometer R1 for 1 Vp-p.
5. Adjust potentiometer R172 for a 100% indication on the video level meter on the control panel.

**Limiter and Detector Balance.** Adjust limiter and detector balance as follows:

1. Supply a flat field, 0% APL test signal to the VIDEO INPUT connector.
2. Connect spectrum analyzer to the junction of integrated circuit A7 pin 8, inductor L3, capacitor C24, and resistor R40.
3. Adjust potentiometer R93 for minimum third harmonic (third harmonic is approximately 24 MHz). Third harmonic must be at least 58 dB below the second harmonic (second harmonic is approximately 16 MHz).
4. Connect spectrum analyzer to the junction of capacitor C11, C22, inductor L2, and collector of Q2.
5. Adjust potentiometers R19 and R30 for minimum carrier frequency (approximately 8 MHz) and minimum third harmonic (approximately 24 MHz). Repeat adjustments of potentiometers R19 and R30 until the carrier and third harmonic are at least 60 dB below the second harmonic (16 kHz).

**Low Pass Filter.** The frequency response of the low pass filter is within 0.1 dB from 1.5 MHz to 4.3 MHz, and down 3 dB at 5.000 MHz ±0.001 MHz. Adjust the filter as follows:

1. Remove jumper J5.
2. Place jumpers J1 and J3 in their A - B position.
3. Connect input of sweep generator to jack J2 on the PWA (J2 is located between jumpers J1 and J3).
4. Connect spectrum analyzer to PWA pin 81/82.
5. Adjust capacitor C82 to set the roll-off knee at 4.3 MHz.
6. Adjust transformers T3 and T1 for minimum ripple from 1 MHz to 4.5 MHz. Transformer T2 is a fine adjustment for minimum ripple. Inductors L7, L9 and L11 are vernier adjustments for transformers and should not have to be adjusted from their nominal (center position) value.
7. Adjust inductor L1 to set the 3 dB point at 5.000 MHz.
8. Adjust inductors L2 and L4 to minimize the ripple in the pass band.
9. Transformers T3 and T1 can be readjusted slightly to improve group delay.

**Monitor Switch Logic and Color Framing Detector PWA, Assembly No. 1373153** PWA-13

Table 3-19 is a jumper list for the monitor switch logic and color framing PWA. A block diagram of the PWA is given in Figure 3-51 and Figure 3-52 shows component locations. Align the PWA as follows:

1. Supply a color bar test signal to the VIDEO IN connector on the rear connector panel.
2. Connect oscilloscope channel 1 probe to test lug E2.
3. Connect oscilloscope channel 2 probe to test lug E5.
4. Trigger oscilloscope from test lug E2.

Table 3-19. Jumper List, Monitor Switcher and Color Framer PWA 13, Assembly No. 1373153 (Continued)

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J6 | A - B and EE<br>Removed | Input video to sync generator.<br>Reference video to sync generator. |
| J7 | A - B and Record<br>Removed | Input video to sync generaotr.<br>Reference video to sync generator. |
| J8 | A - B and editor on<br>Removed | Input video to sync generator.<br>Reference video to sync generator. |
| J9 | A - B<br>A - C | 525 line.<br>625 line. |
| J10 | A - B<br>B - C | NORMAL<br>Test for adjusting. |

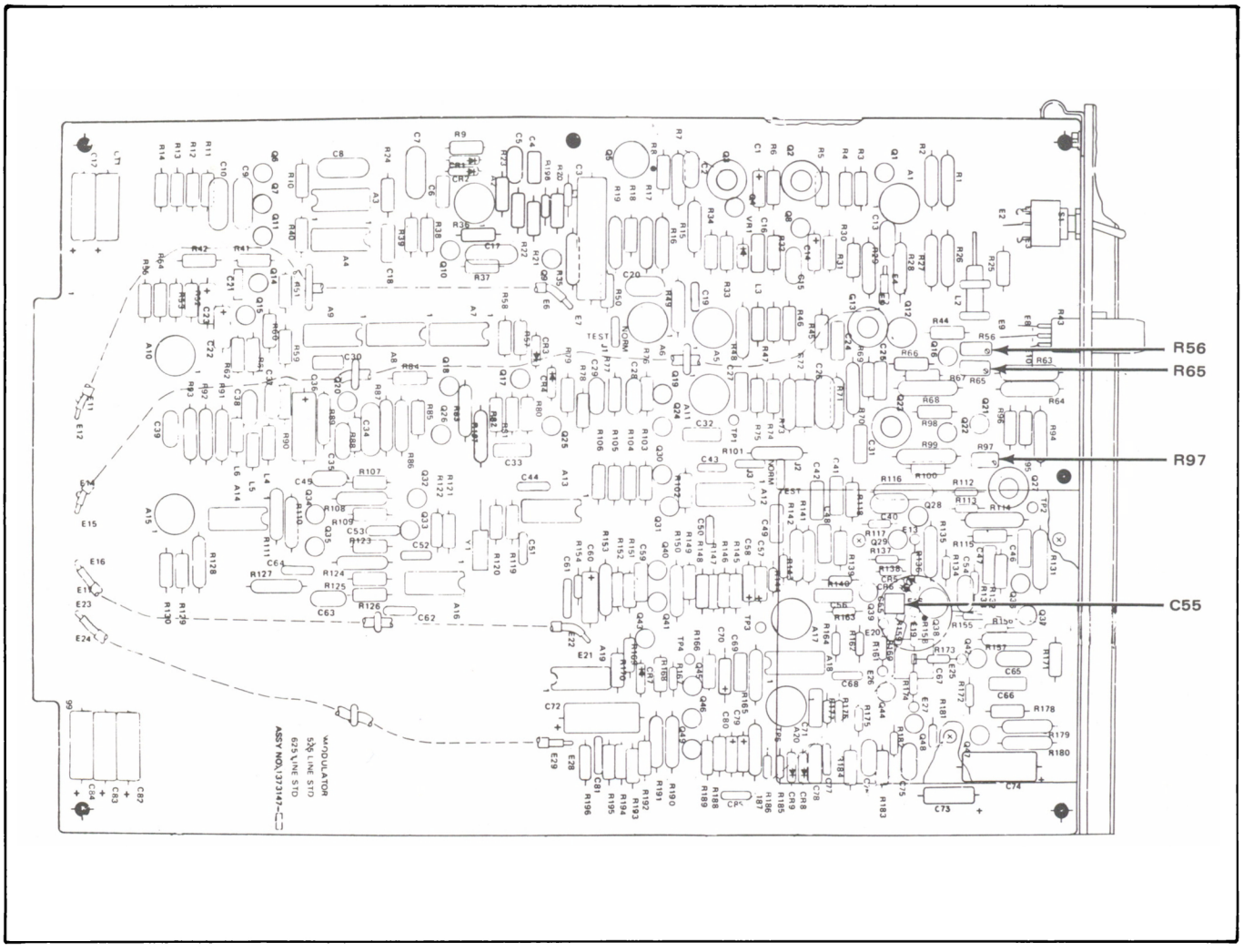



Figure 3-49. Modulator PWA 12, Assembly No. 1373147

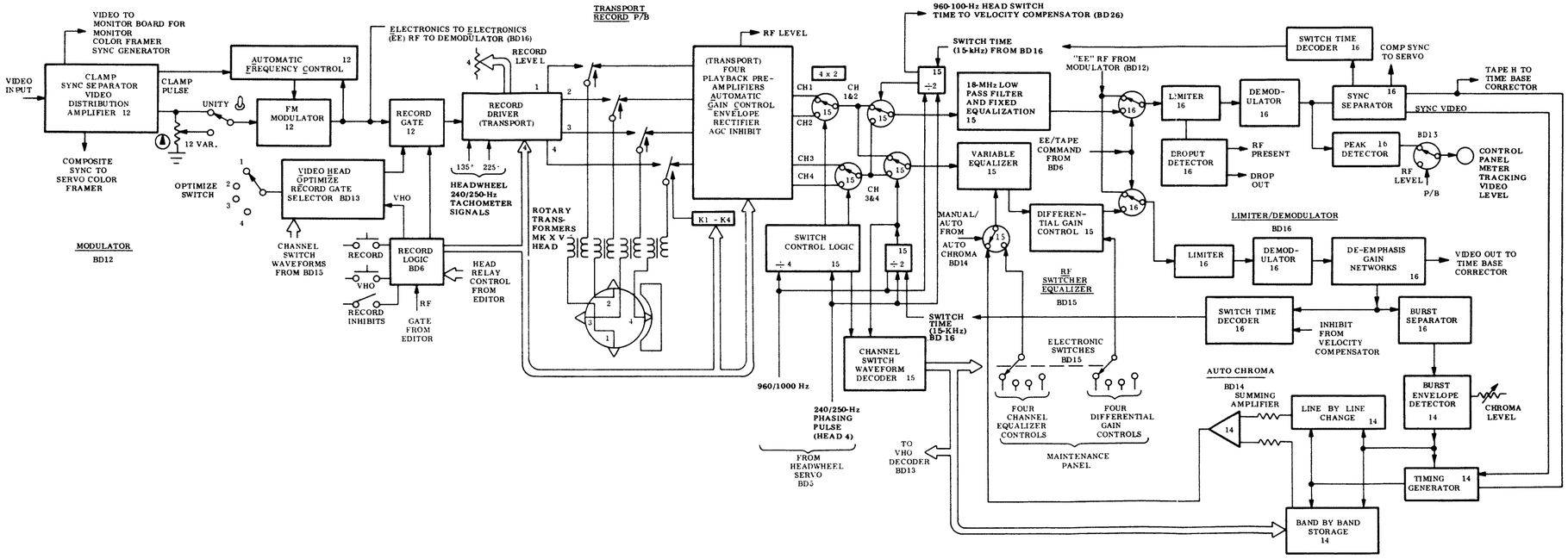



Figure 3-46. Video Signal System Block Diagram

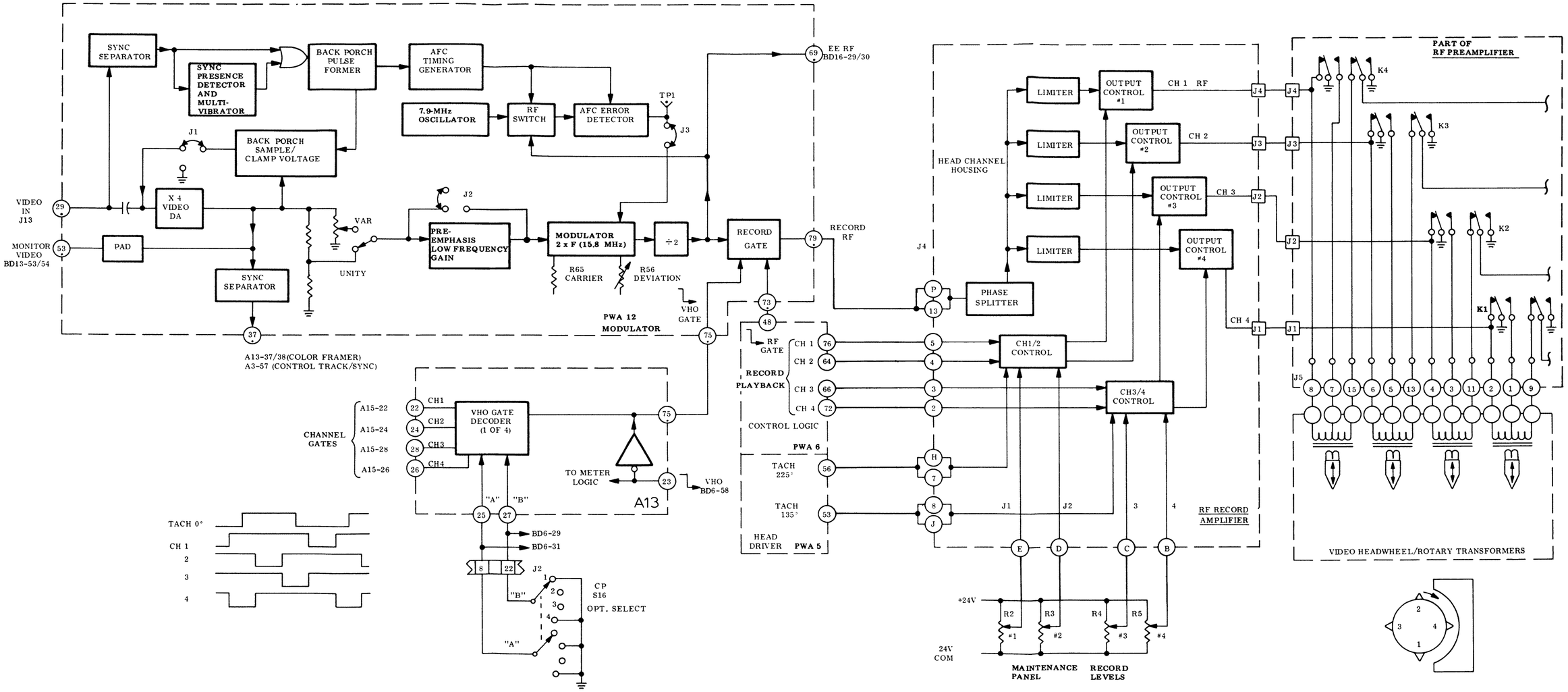



Figure 3-47. Video Signal System (Record Mode) Block Diagram

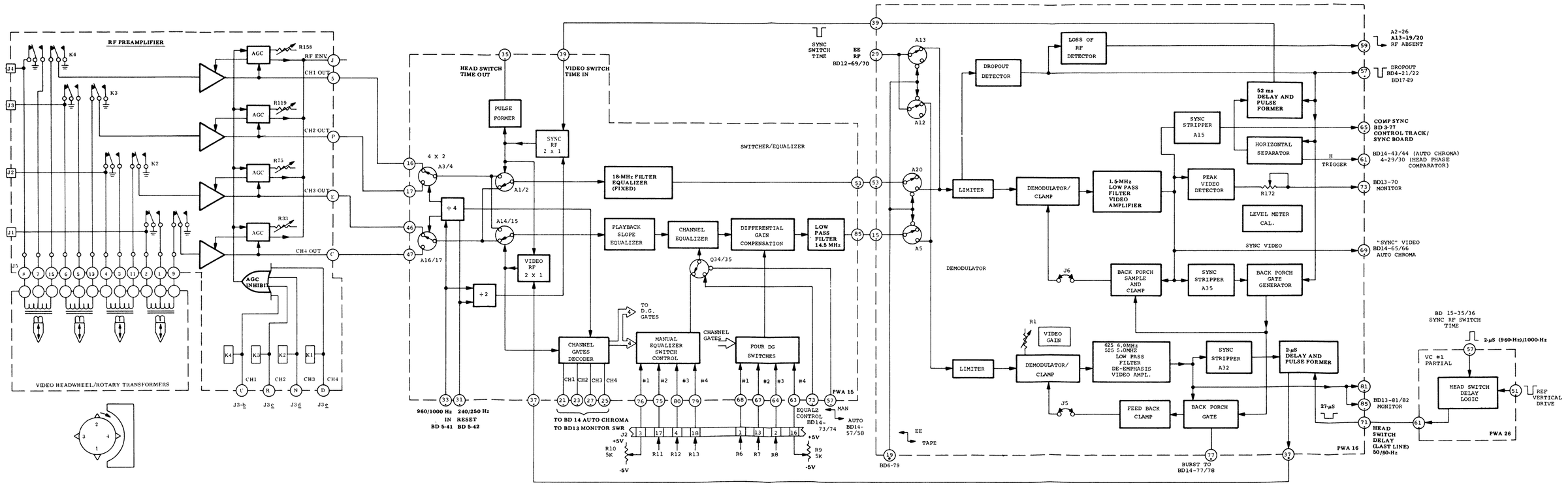



**Figure 3-48. Video Signal System (Playback Mode) Block Diagram**

Table 3-17. Jumper List, Modulator PWA 12, Assembly No. 1373147

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL |
| | B - C | Test – clamps video to ground. |
| J2 | A - B | NORMAL |
| | B - C | Test – eliminates pre-emphasis. |
| J3 | A - B | NORMAL |
| | Removed | Test – eliminates AFC. |

Table 3-18. Jumper List, Demodulator PWA 16, Assembly No. 1373058

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - C | NORMAL |
| | A - B | Test – removes pulses to low pass filter. |
| J2 | | Coax connector for inserting sweep to low pass filter. |
| J3 | A - C | NORMAL |
| | A - B | Test – removes pulses to low pass filter. |
| J4 | A - B | NORMAL |
| | A - C | Test |
| J5 | A - B | NORMAL |
| | Removed | Test – removes clamp to pulse switch (video path). |
| J6 | A - B | NORMAL |
| | Removed | Test – removes clamp to pulse switch (sync video path). |
| J7 | Removed | NORMAL |
| | A - B | Disables de-emphasis. |

Table 3-19. Jumper List, Monitor Switcher and Color Framer PWA 13, Assembly No. 1373153

| JUMPER | POSITION | REMARKS |
|---|---|---|
| | | NOTE |
| | | **J1 through J5 selects modes of video muting.** |
| J1 | A - B and EE | No video muting. |
| | Removed | Video muted. |
| J2 | A - B and Record | No video muting. |
| | Removed | Video muted. |
| J3 | A - B and RF present | No video muting. |
| | Removed | Video muted. |
| J4 | A - B and Servo Locked | No video muting. |
| | Removed | Video muted. |
| J5 | A - B and Editor on | No video muting. |
| | Removed | Video muted. |
| | | NOTE |
| | | **J6 through J8 selects reference to sync gen.** |

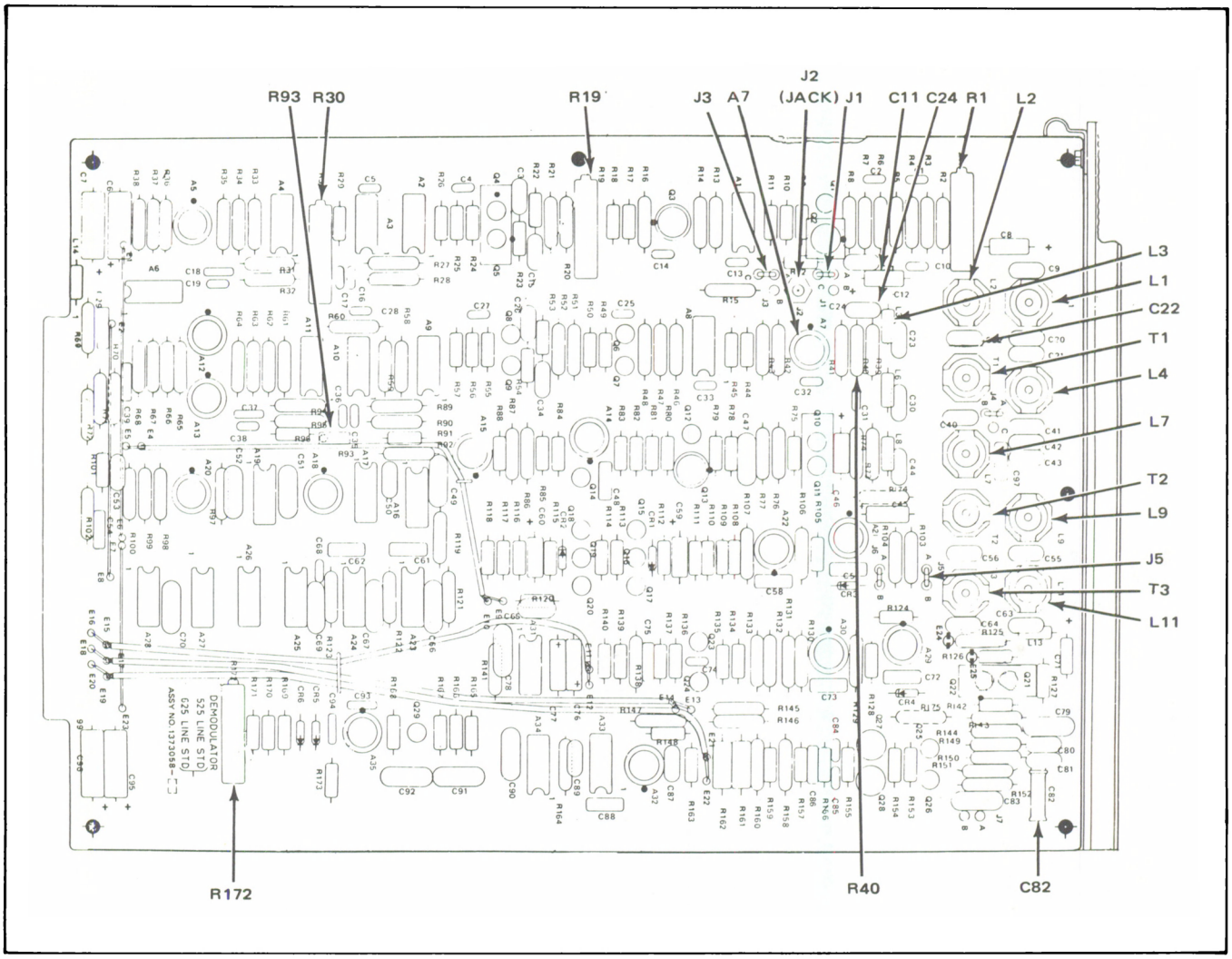



**Figure 3-50. Demodulator PWA 10, Assembly No. 1373058**

5. Adjust potentiometer R61 so that burst is centered around pulse at test lug E2 and the pulse is coincident with the negative crossing of a cycle of burst (see Figure 3-53).

## RF Record Amplifier PWA, Assembly No. 1373143.

The RF Record Amplifier PWA, Assembly No. 1373143, is located in the head channel housing assembly beneath the transport top plate (see Figure 3-10). A simplified schematic diagram of the rf record amplifier is given in Figure 3-54.

### CAUTION

**THE FOLLOWING PROCEDURES ARE NOT TO BE ROUTINELY PERFORMED. THE ADJUSTMENTS CALLED FOR ARE PERFORMED AT THE FACTORY AT THE TIME OF THE PWA's MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD UNLESS THE NEED FOR IT IS CERTAIN AND THE REQUIRED TEST EQUIPMENT IS ACQUIRED.**

Adjust the RF Record Amplifier PWA, Assembly No. 1373143,as follows:

1. Connect an 8.5-MHz test signal with a second harmonic content more than 63 dB below the fundamental to PWA pin 13.

13. Adjust potentiometer R121 so that burst occupies 4 cm on the oscilloscope (burst level equal to sync level).

### Switcher and Equalizer PWA, Assembly No. 1373055

Adjustment for the switcher and equalizer PWA are not provided. A jumper list is provided in Table 3-21.

**Table 3-20. Jumper List, NTSC Auto Chroma PWA, Assembly No. 1373165**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | | Wire jumper. |
| J2 | A - B | 525 (3.58 MHz). |

## DIGITAL TIME-BASE CORRECTOR

The following paragraphs contain checkout and alignment procedures for ensuring proper operation of the digital time-base corrector subsystem of the AVR-2. These adjustments should not be considered routine alignment procedures. The adjustments have been performed at the factory to close tolerances and subsequent adjustment should not be required. These procedures should be performed only when a repaired or replacement PWA has otherwise become misadjusted. They are also useful as troubleshooting reference. Any measurement noted that is grossly out of tolerance should be troubleshot to locate a component fault.

Some adjustments included here are labeled factory adjustments. Factory adjustments are not normally to be performed in the field and are given here as reference only.

The following conditions apply to the digital time-base corrector alignment procedures.

- AVR-2 in E-E standby unless otherwise specified.
- Input to AVR-2 to be 1 Vp-p color bar signal with 75% saturation unless otherwise specified.
- All measurements of pulses for timing and width are taken at the half amplitude point.
- All input and output video signal measurements are taken with signals terminated into precision 75-ohm terminations.
- Factory adjustments will be listed as such but will also be explained. The factory adjustments can be performed if the appropriate test equipment is acquired.

Figure 3-60 is a simplified block diagram of the digital time-base corrector and Figure 3-61 is a detailed block diagram.

### DTBC Video Input PWA 17, Assembly No. 1374010.

Table 3-22 is a jumper list for the video input PWA. Align the Video Input PWA, Assembly No. 1374010, as follows.

**Table 3-21. Jumper List, Switcher and Equalizer Assembly No. 1373055**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL |
| | B - C | Test, disconnects input signal from equalizer and connects the test jack (J2) to the equalizer input. |
| J3 | A - B | NORMAL; connects signal to master equalizer. |
| | Removed | Test; equalizer setup. |
| J4 | A - B | NORMAL; connects signal to low pass filter. |
| | A - C | Test; equalizer setup. |
| | B - C | Test; low pass filter setup. |
| J6 | Removed | NORMAL |
| | A - B | Test; bypasses the differential gain adjustment network. |
| J7 | Removed | NORMAL |

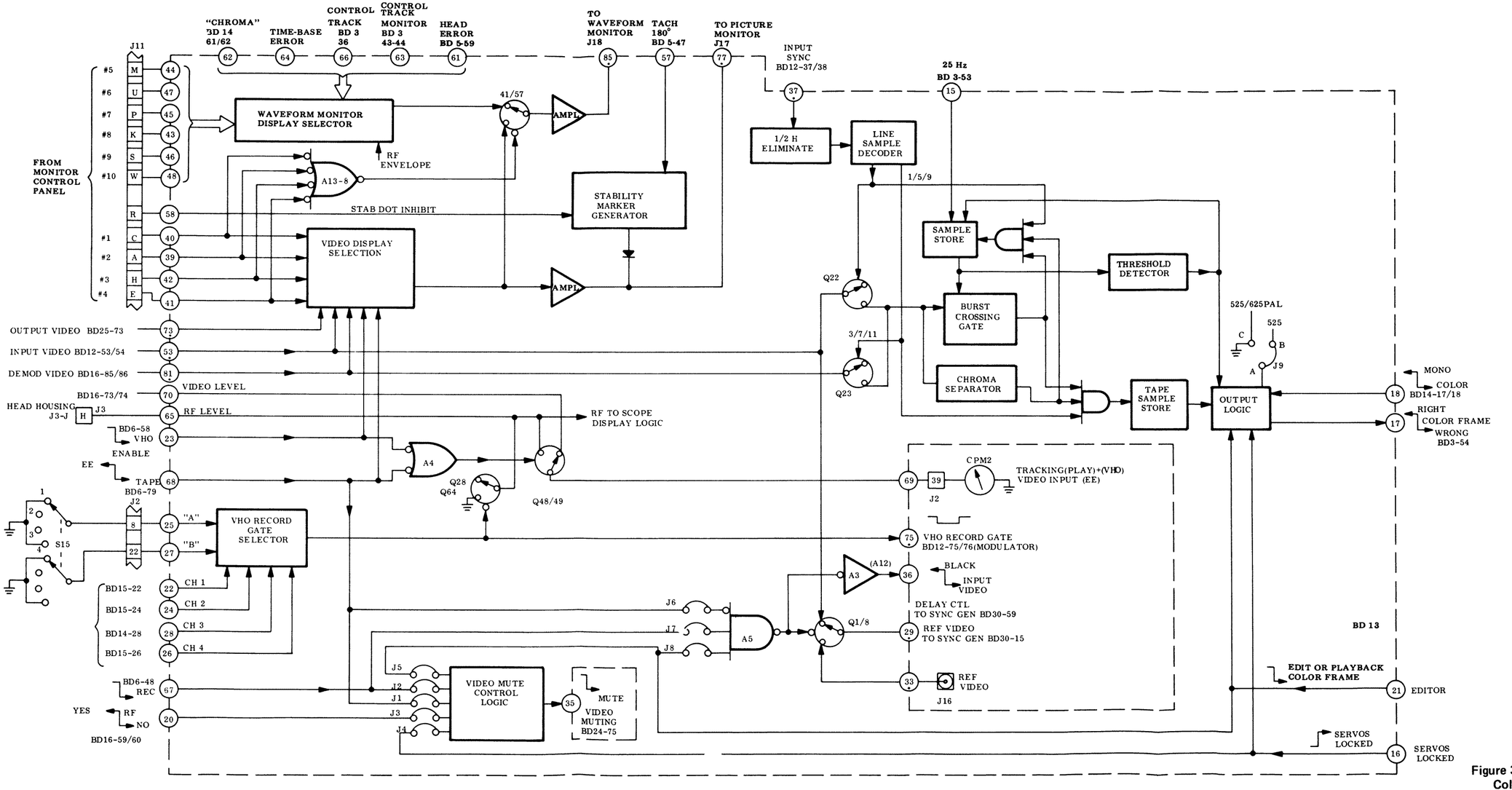



Figure 3-51. Monitor Switch Logic and Color Framing PWA Block Diagram

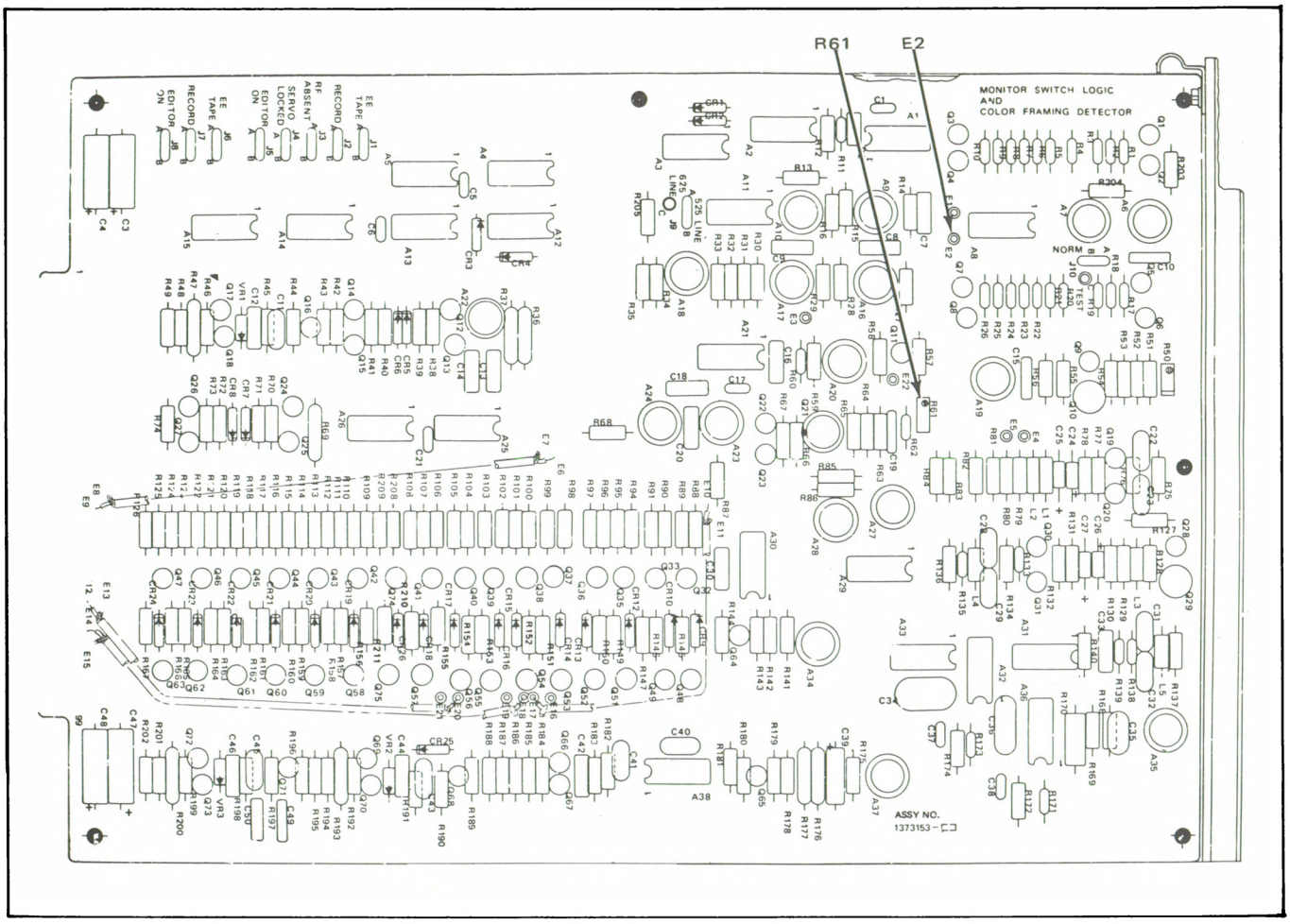
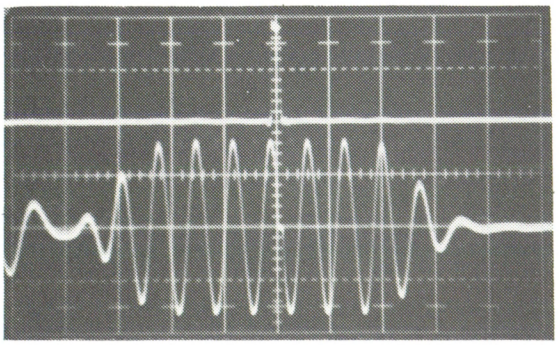



Figure 3-52. Monitor Switch Logic and Color Framing Detector PWA, Assembly No. 1373153



CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E2 |
| VERTICAL SENSITIVITY: | 0.01V/CM |
| PROBE: | X 10 |
| TRIGGER: | E2 |
| SWEEP RATE: | 0.2 μS/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E5 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |

Figure 3-53. Monitor Switch Logic and Color Framing Detector PWA Adjustment Waveform

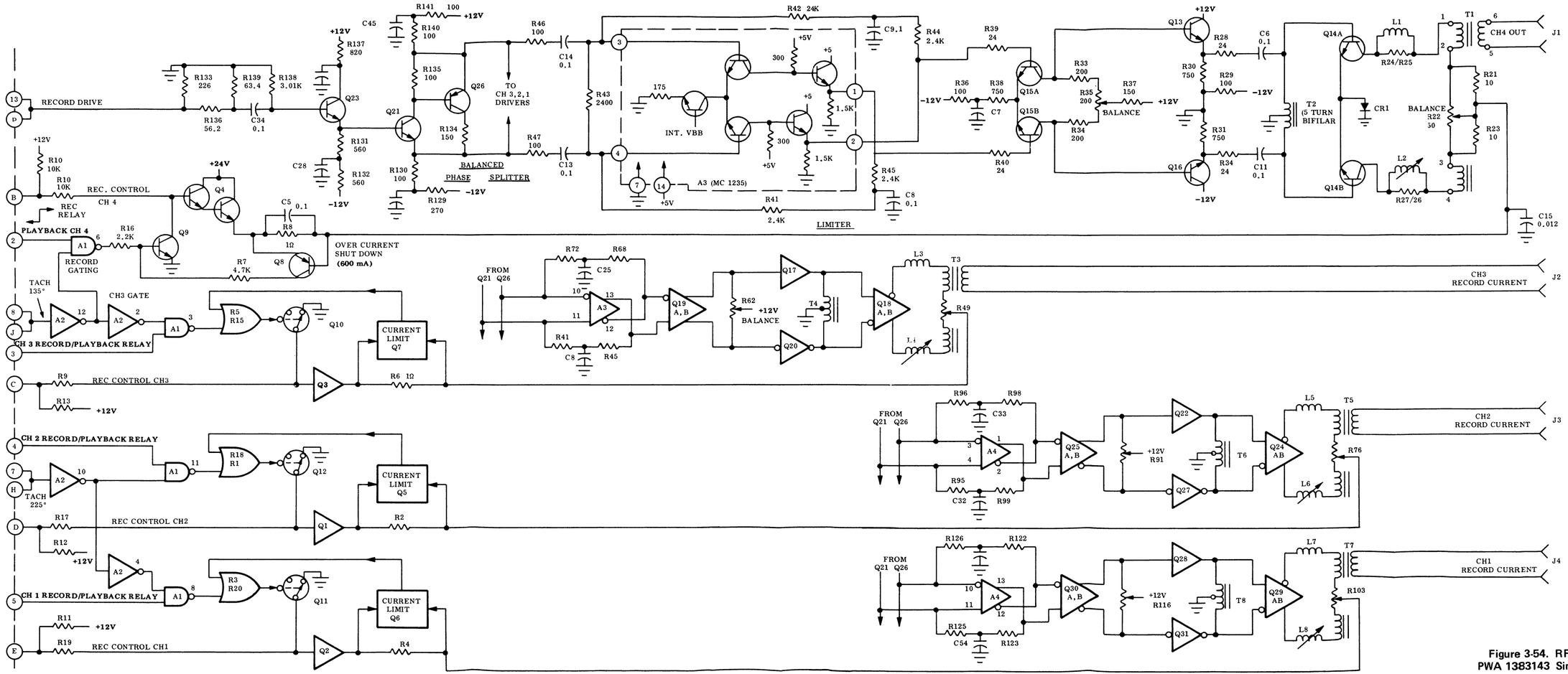



**Figure 3-54. RF Record Amplifier PWA 1383143 Simplified Schematic**

2. Connect spectrum analyzer to the junction of potentiometer R35 and resistor R37 (see Figure 3-55).

3. Adjust potentiometer R35 for minimum carrier signal (8.5 MHz).

4. Connect spectrum analyzer to PWA connector J1 with a 50-ohm coax cable.

5. Set VIDEO RECORD – CHAN 1 control on the maintenance panel of the recorder for a drive level of 3 dB below maximum.

6. Adjust inductor L2 and potentiometer R22 for minimum second harmonic content.

7. Set VIDEO RECORD – CHAN 1 control on the maintenance panel for a drive level of 23 dB below maximum output.

8. Readjust potentiometer R35 slightly for minimum second harmonic. Final adjustment is for second harmonic to be 60 dB below fundamental, from 3 dB below to 23 dB below maximum output.

9. Perform the counterpart of the above adjustment for channels 2, 3 and 4.

**RF Preamplifier PWA, Assembly No. 1373005**

The rf preamplifier PWA is located in the head channel housing assembly beneath the transport top plate (see Figure 3-10). A simplified schematic diagram of the rf preamplifier assembly is given in Figure 3-56.

**CAUTION**

**THE FOLLOWING PROCEDURES ARE GIVEN FOR INFORMATION ONLY. THE ADJUSTMENTS CALLED FOR ARE PERFORMED AT THE FACTORY AT THE TIME OF THE PWA'S MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD.**

Adjust the RF Preamplifier PWA, Assembly No. 1373005, as follows:

1. With the video head supplying a nominal output, adjust potentiometer R75 (see Figure 3-57) for a 150-mV output at PWA pins E/5.

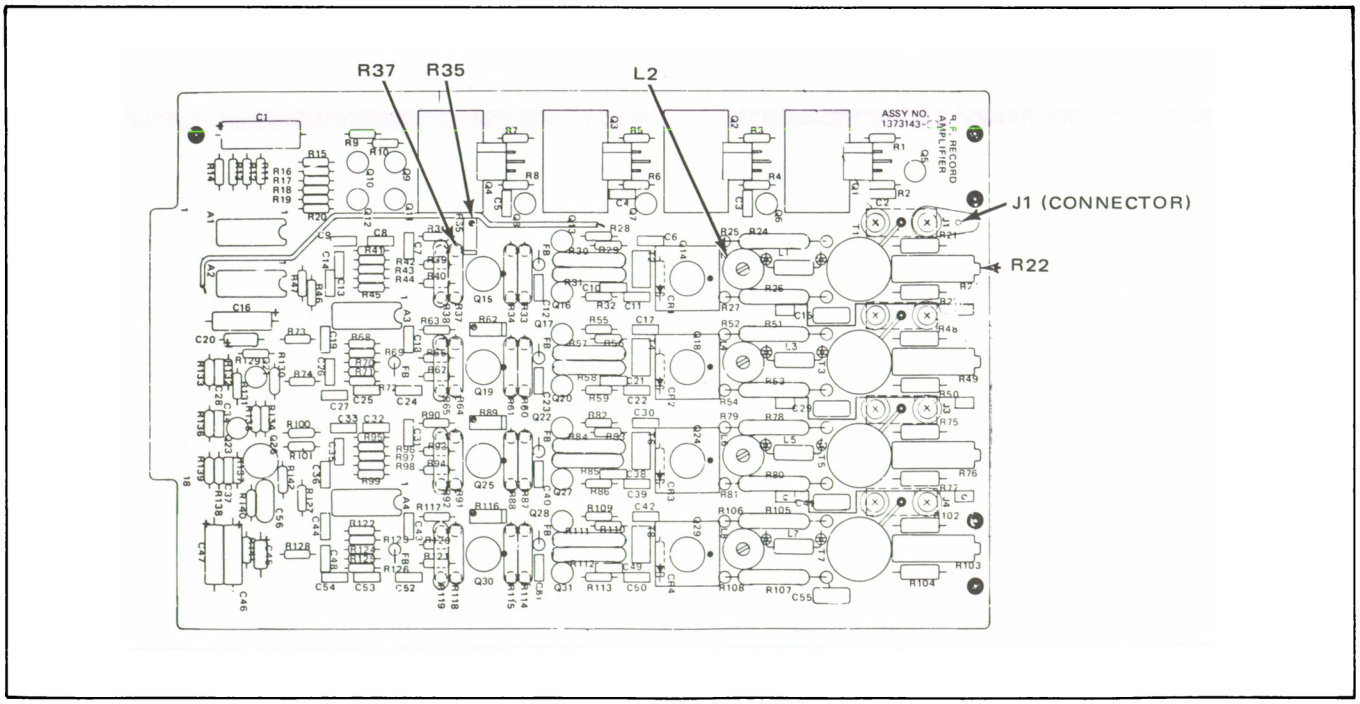



Figure 3-55. RF Record Amplifier PWA Assembly No. 1373143

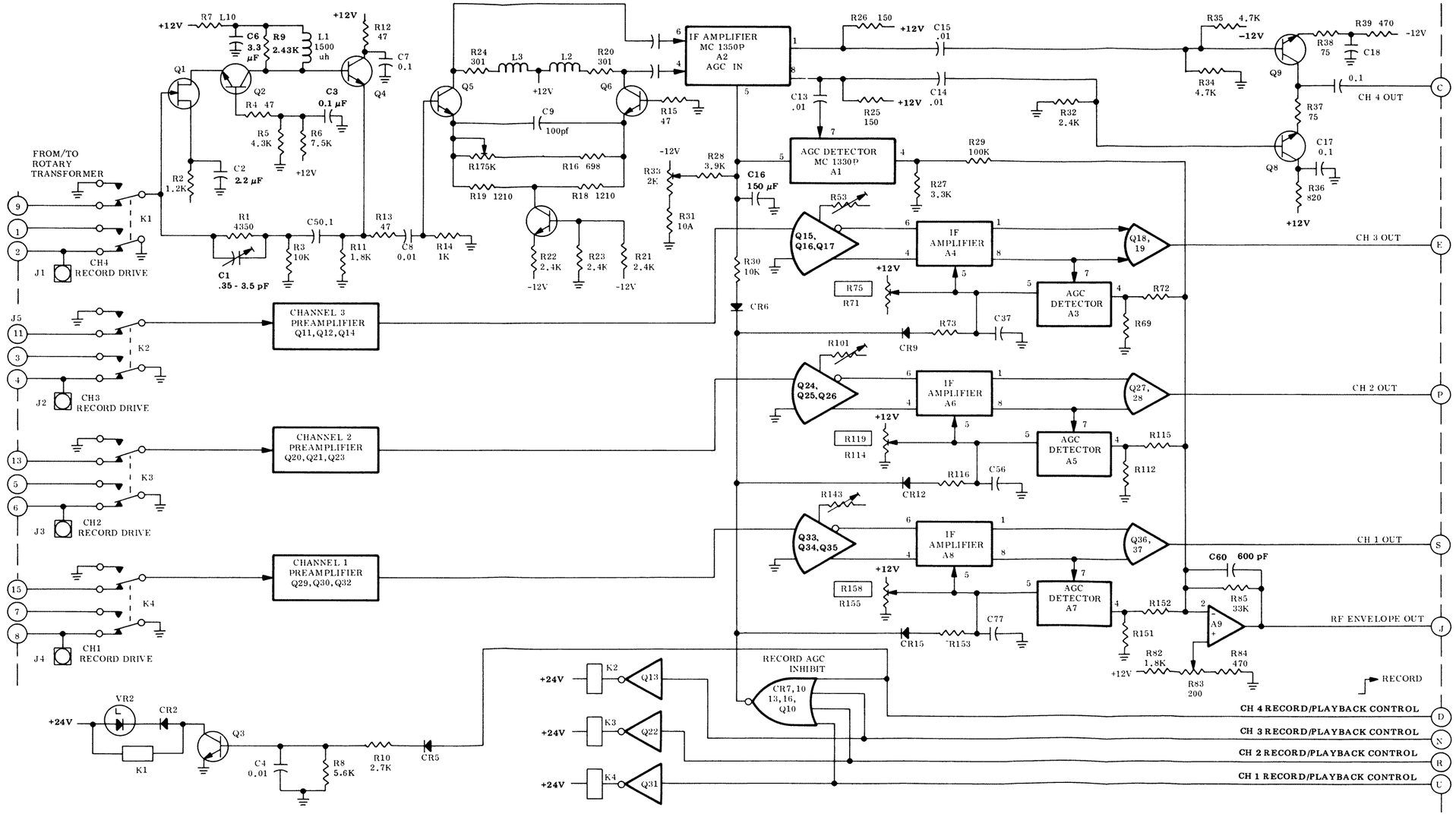



**Figure 3-56. RF Preamplifier PWA 1373005 Simplified Schematic Diagram**

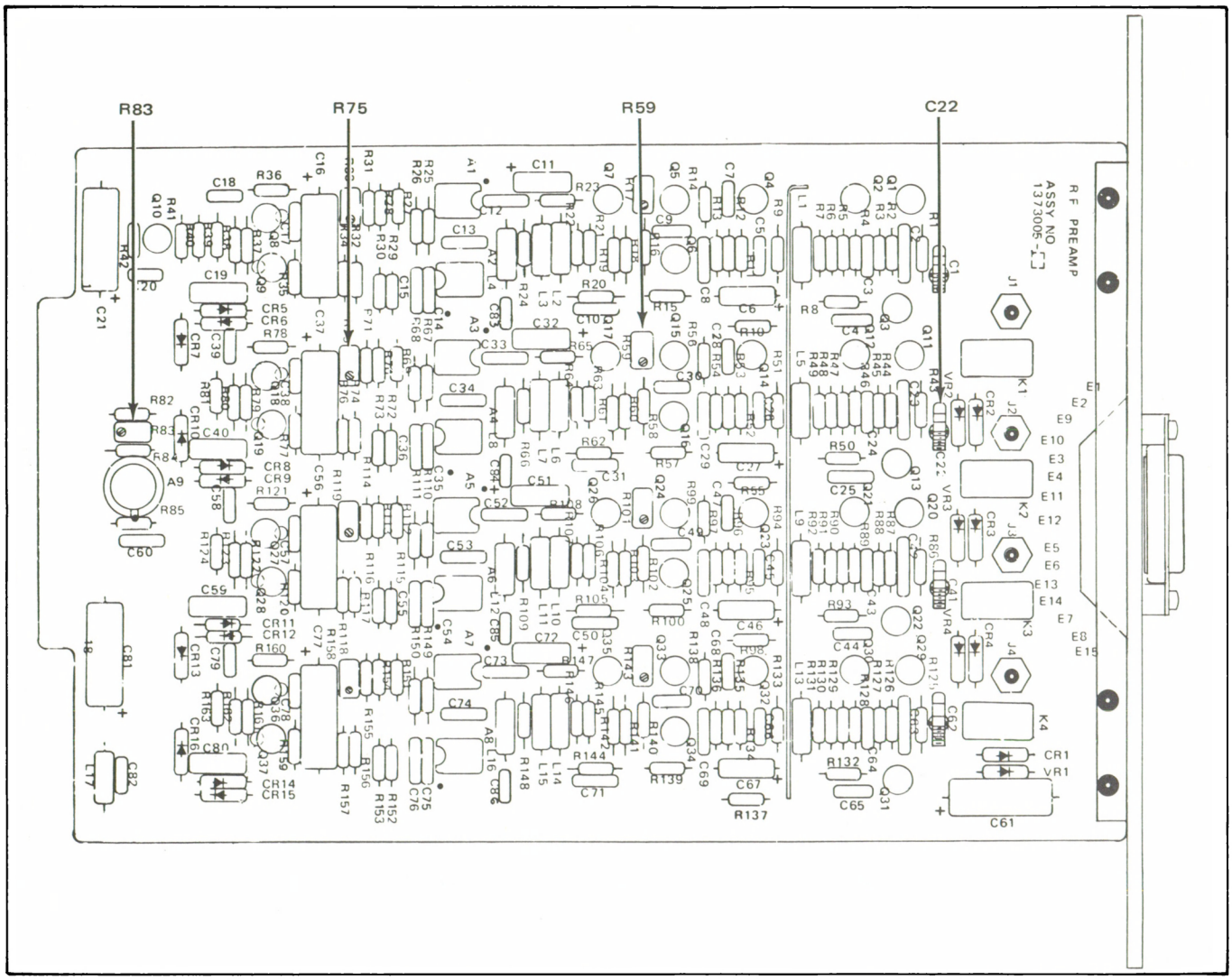



**Figure 3-57. RF Preamplifier PWA, Assembly No. 1373005**

2. Observe that the output level after a 10-dB drop in video head output is 135 ±5 mV.

3. Observe that the output level after a 10-dB increase in video head output is 160 ±5 mV.

4. Select RF LEVEL on the monitor control panel.

5. Adjust potentiometer R83 so that negative portion of signal is at zero volts dc.

6. Adjust potentiometer R59 and capacitor C22 for –0.25 dB from 1.2 MHz to 5.0 MHz, ±0.1 dB from 5.0 MHz to 10.0 MHz, and –0.5 dB to 14 MHz.

7. Perform counterpart of above procedures for each of the remaining three channels.

## Auto Chroma PWA, Assembly No. 1373165

The jumper list for the auto chroma PWA is found in Table 3-20. A block diagram of the PWA is given in Figure 3-58. Align the Auto Chroma PWA, Assembly No. 1373165, as follows.

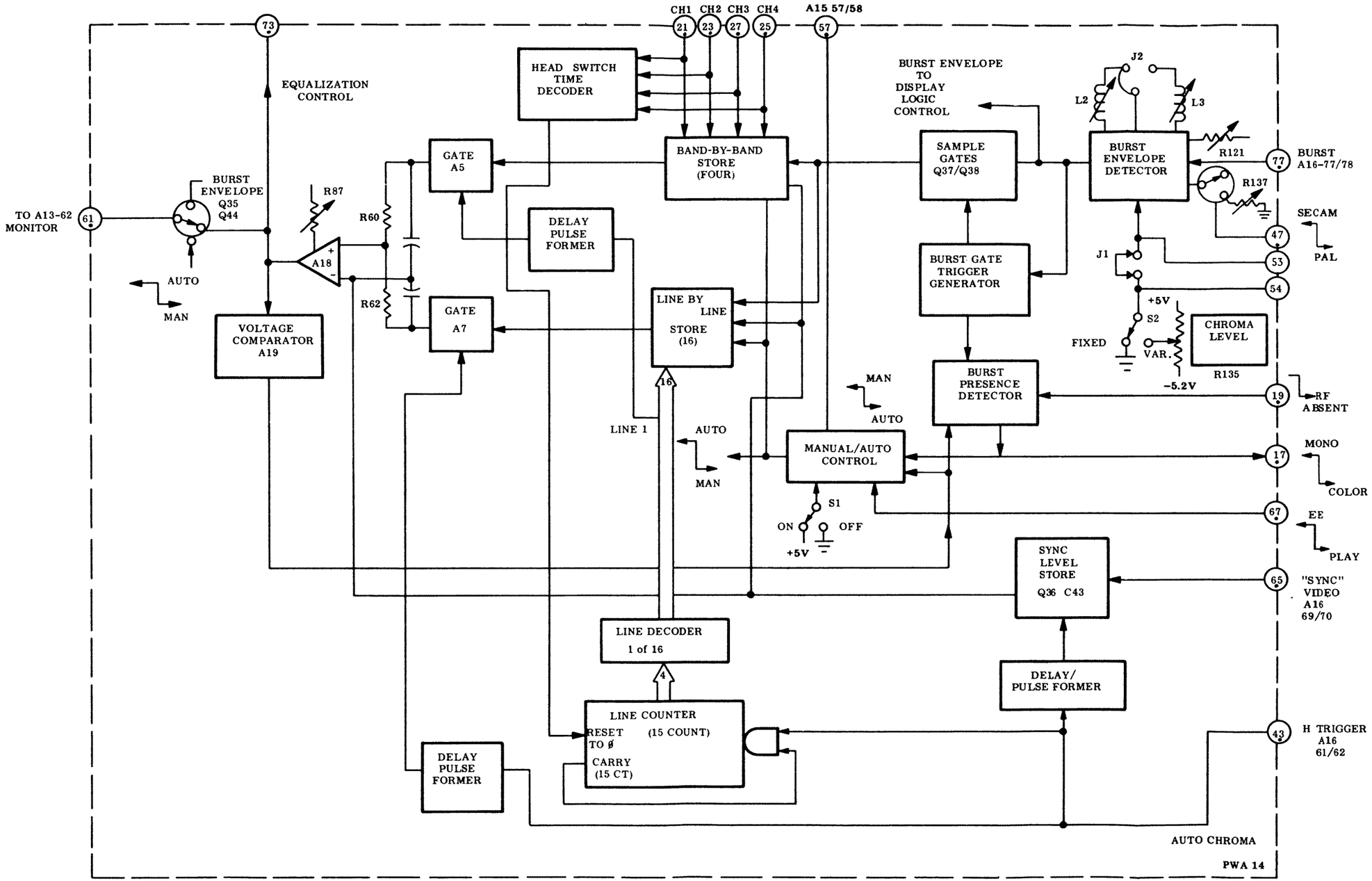



Figure 3-58. Auto Chroma PWA 1373165, Block Diagram

1. Connect a color bar test signal to the VIDEO INPUT connector on the rear connector panel.
2. Connect oscilloscope channel 1 probe to PWA pin 73/74.
3. Adjust potentiometer R87 (see Figure 3-59) for zero volts dc.
4. Connect oscilloscope channel 1 probe to pin 5 of A29 and adjust scope for positive internal triggering.
5. Adjust inductor L2 for maximum pulse amplitude.
6. Record two minutes of color bars.
7. Connect oscilloscope channel 1 probe to VIDEO OUT MONITOR connector.
8. Select DEMOD OUT on the monitor control panel.
9. Uncalibrate the scope to have the sync occupy 4 cm on the scope.
10. Set ON – OFF toggle switch on auto chroma PWA to ON.
11. Set CHROMA LEVEL UNITY/VARIABLE switch to UNITY.
12. Play back the color bar recording.

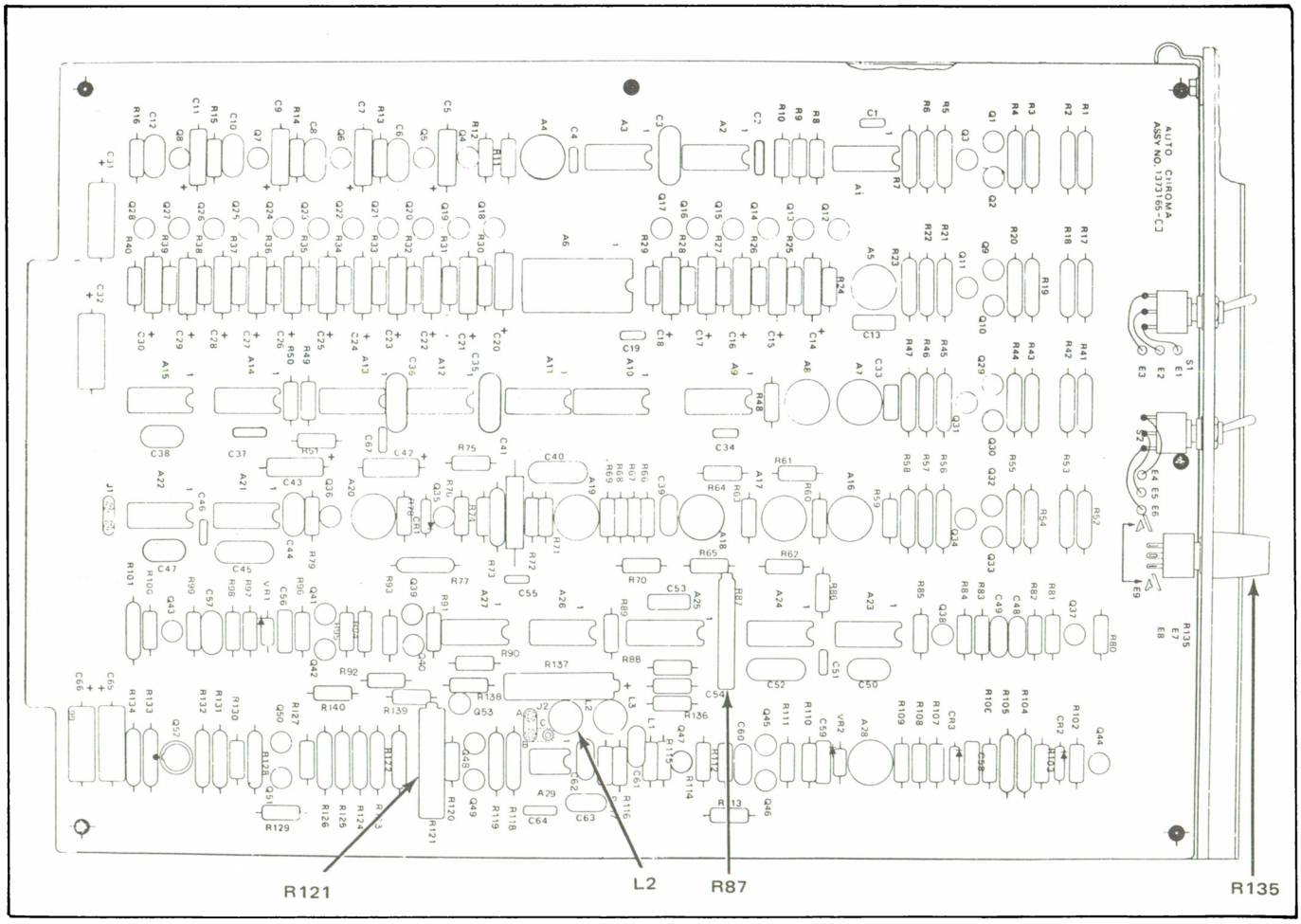



Figure 3-59. Auto Chroma PWA, Assembly No. 1373165

1. Connect oscilloscope channel 1 probe to tie lug E17 (video input).

2. Connect oscilloscope channel 2 probe to tie lug E2 (see Figure 3-62).

3. Trigger oscilloscope from PWA pin 35 (H sync).

4. Adjust potentiometer R3 (delay) so that positive edge of signal at tie lug E2 starts 2.2$\mu$s after the leading edge of H sync signal at tie lug E17 (see Figure 3-63A).

5. Connect oscilloscope channel 1 probe to tie lug E3.

6. Connect oscilloscope channel 2 probe to tie lug E5.

7. Adjust potentiometer R7 (window) so positive edge of signal at E5 starts 2.5$\mu$s before the negative edge of signal at E3 (see Figure 3-63B).

NOTE

**Steps 8, 9 and 10 are a preliminary adjustment and should only be done if a complete analog-to-digital and digital-to-analog alignment is being performed. Refer to *DTBC Unity Gain Adjustment Procedure* for final adjustment of R126 (unity black level).**

8. Connect oscilloscope channel 1 probe to PWA pin 83 (video out).

9. Set UNITY/VARIABLE switch to UNITY.

10. Adjust potentiometer R126 (unity black level) so that the step in the leading edge of horizontal sync in signal at PWA pin 83 is 400 mV below blanking level (see Figure 3-63C).

11. Connect oscilloscope channel 1 probe to tie lug E32 (mono burst).

**Table 3-22. Jumper List, Video Input PWA 17, Assembly No. 1374010**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL |
| | B - C | Enables test ramp – test ramp is used for troubleshooting and adjustment of A/D A and B. |
| J2 | A - B | NORMAL |
| | B - C | Enables fixed pulse timing for adjustment of R78 (D.O. hold). |
| J3 | A - B | NORMAL |
| | B - C | Forces monochrome operation. |
| | Removed | Forces color operation. |
| | | **NOTE** |
| | | **J4 and J5 used in conjunction with DOC** |
| J4 | A - B | NORMAL – with DOC |
| | A - B | Without DOC or J5 in B to C. Dropouts replaced with black video. |
| | Removed | Without DOC on J5 in B to C. Dropouts replaced with noise. |
| J5 | A - B | Normal – with DOC. |
| | B - C | No DOC operation. |

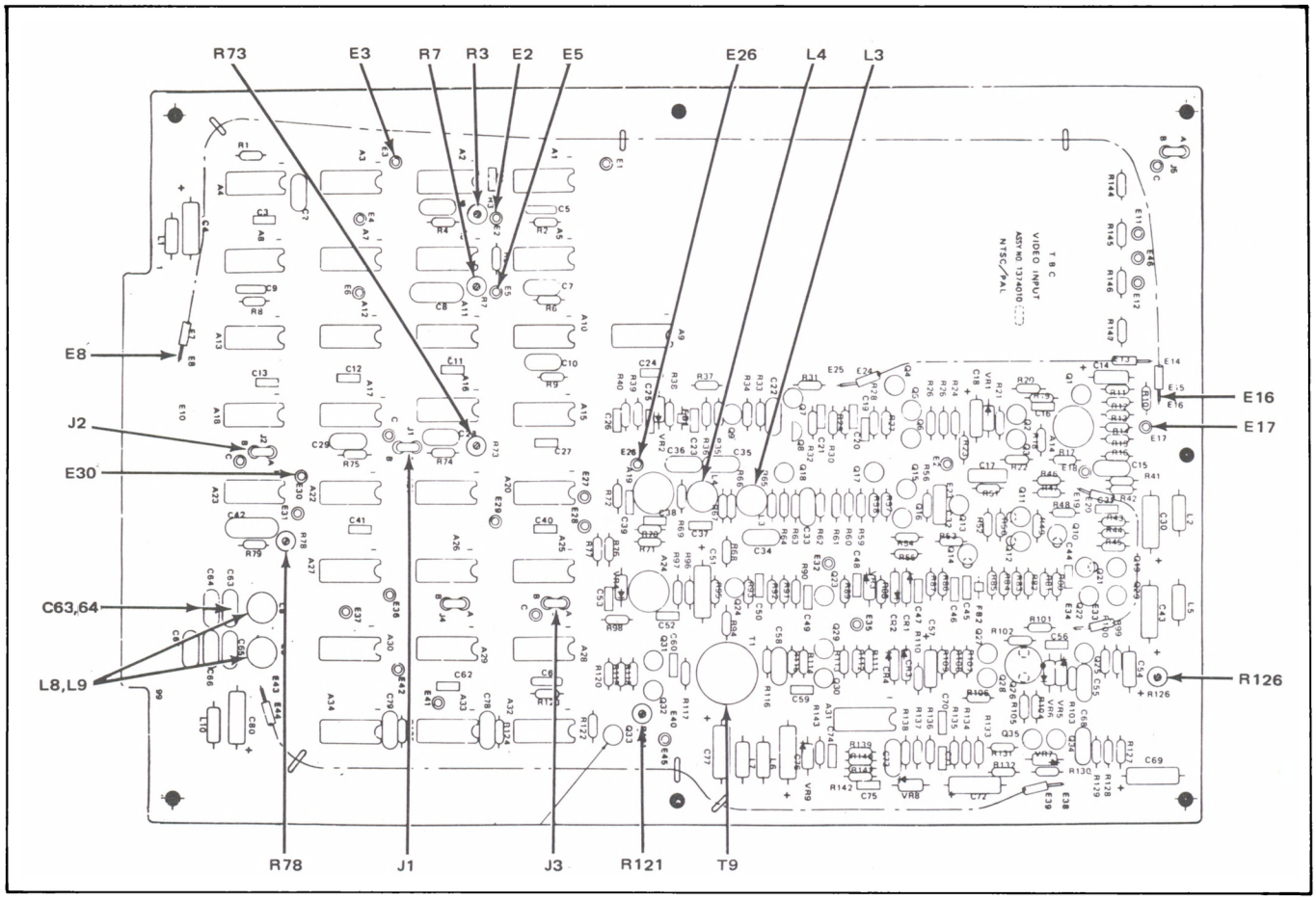



**Figure 3-62. DTBC Video Input PWA 17, Assembly No. 1374010**

12. Connect oscilloscope channel 2 probe to tie lug E17 (video in).

13. Set jumper J3 to B - C position (monochrome).

14. Adjust transformer T1 for mono burst frequency of 3.58 MHz (see Figure 3-63D). Determine mono burst frequency by comparing with burst on video input.

15. Connect oscilloscope channel 1 probe to PWA pin 83. Remove oscilloscope channel 2 probe from tie lug E17. Trigger oscilloscope from Tie lug E32.

16. Adjust potentiometer R121 so that the third cycle of the mono burst at PWA pin 83 is 0.8 Vp-p (see Figure 3-63 E).

17. Replace jumper J3 to A - B position.

18. Connect oscilloscope channel 1 probe to tie lug E26, trigger oscilloscope from PWA pin 35.

19. Adjust inductors L3 and L4 for maximum amplitude of 3.58-MHz burst.

20. Connect oscilloscope channel 1 probe to PWA pin 29 (detected dropout).

21. Connect oscilloscope channel 2 probe to PWA 15 (processed dropout). Trigger oscilloscope from PWA pin 29.

22. While playing back a tape containing programmed dropouts, adjust potentiometer

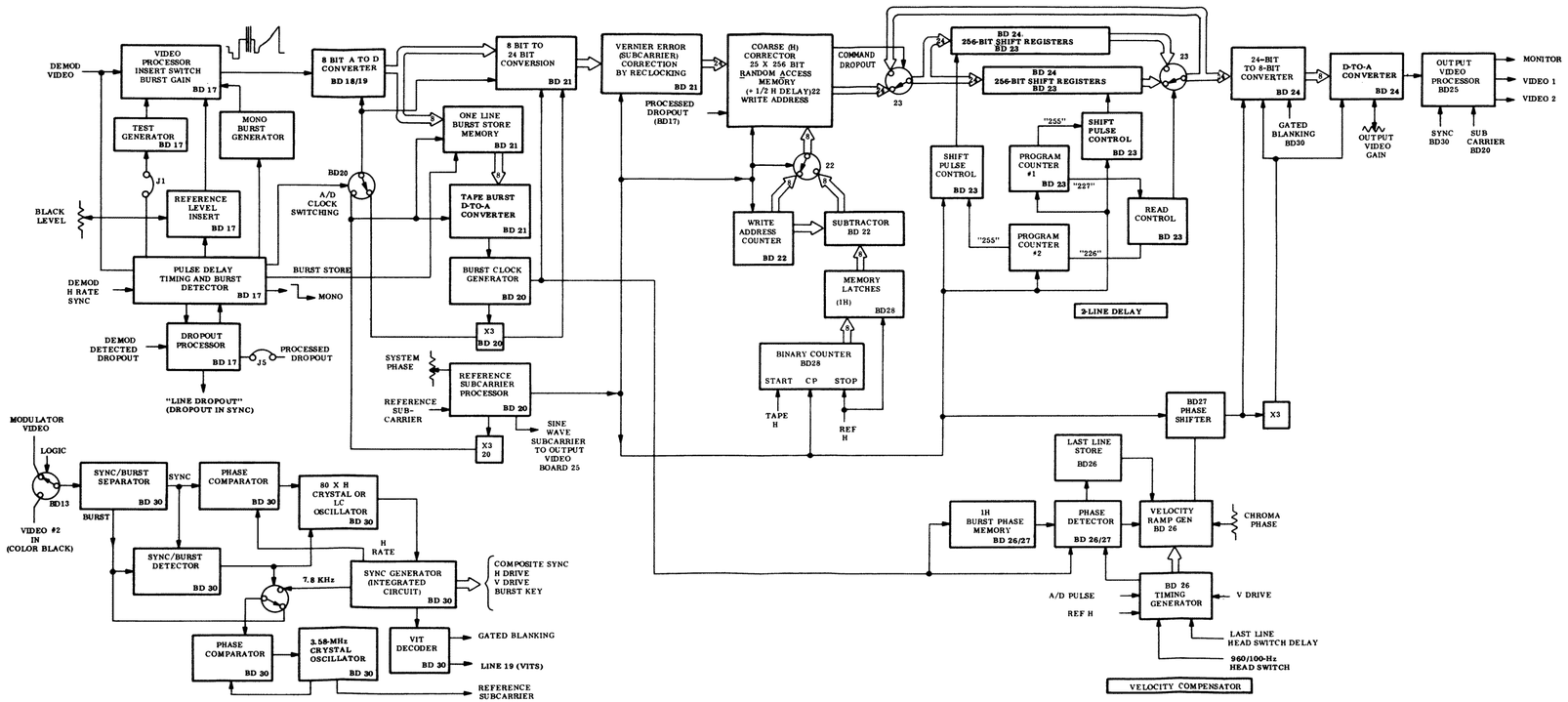



Figure 3-60. Time Base Corrector Overall Block Diagram

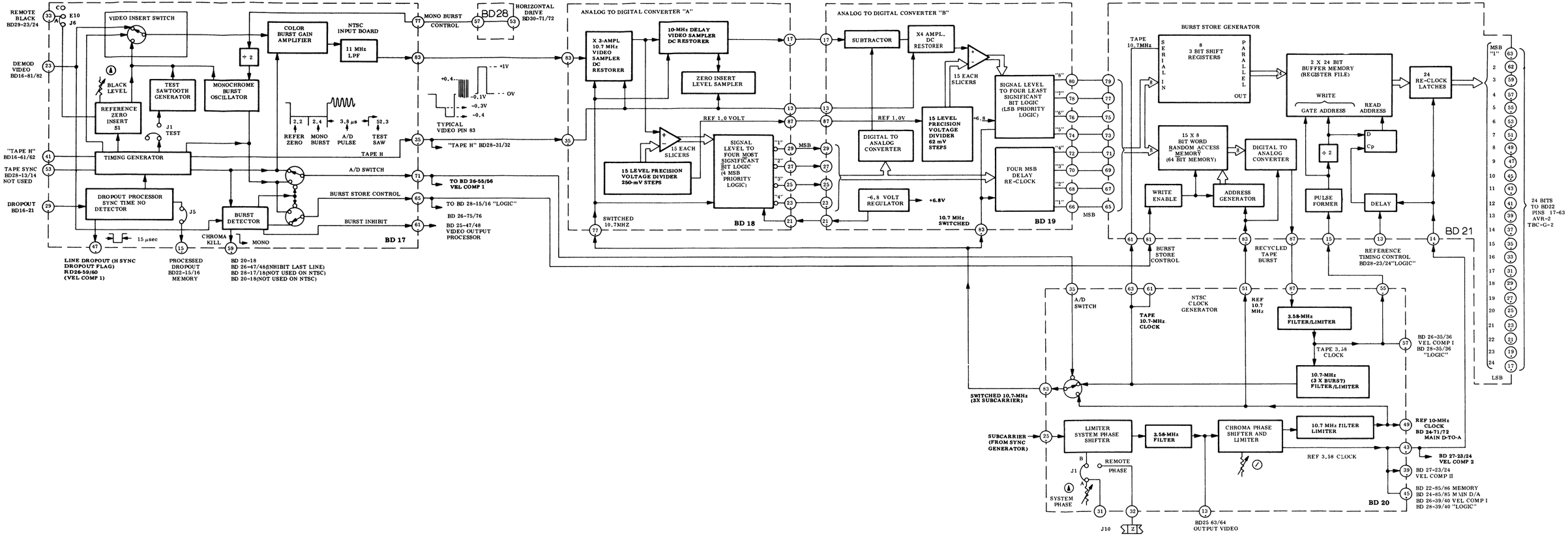



**Figure 3-61. Time Base Corrector Functional Block Diagram (Sheet 1 of 3)**

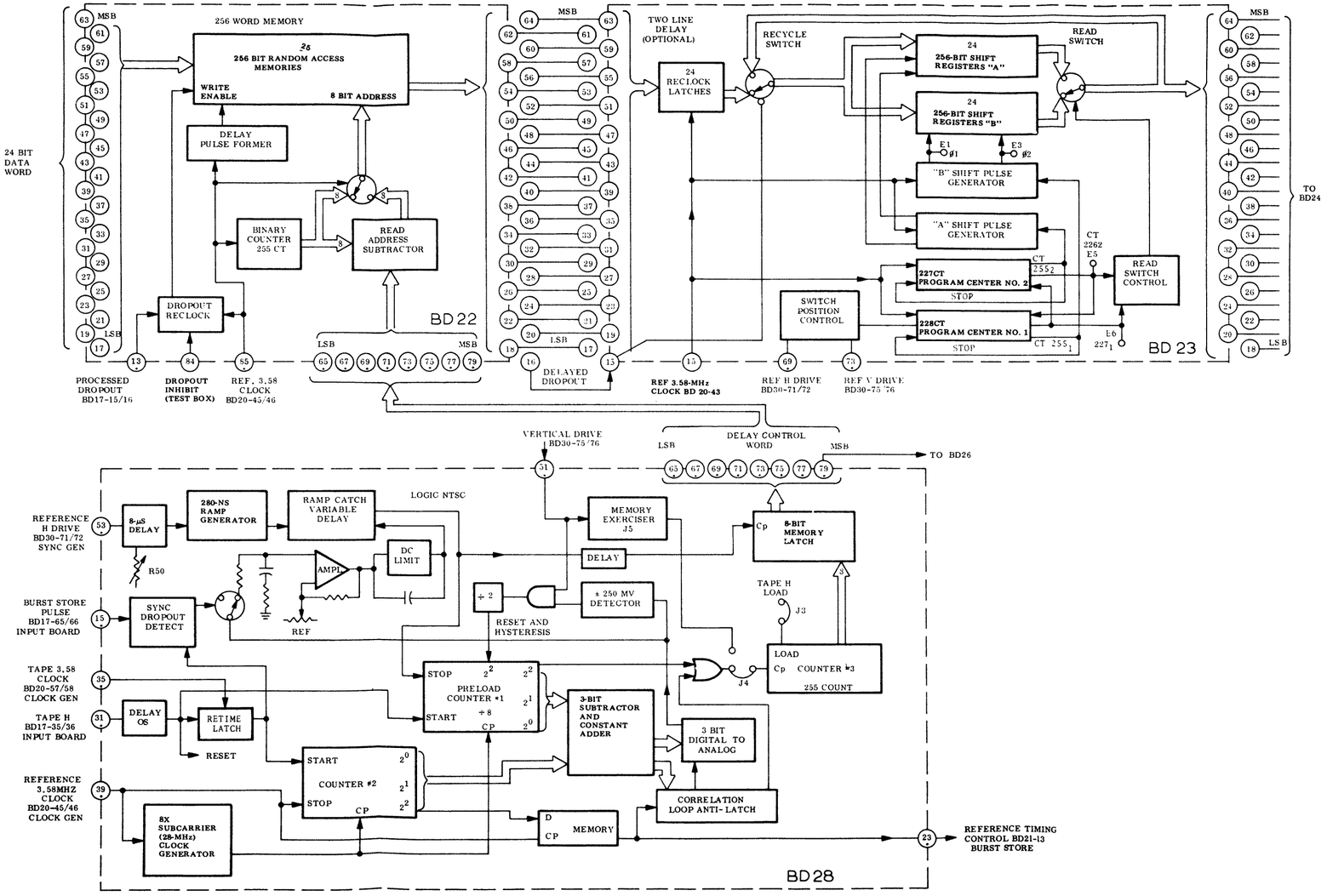



**Figure 3-61. Time Base Corrector Functional Block Diagram (Sheet 2 of 3)**

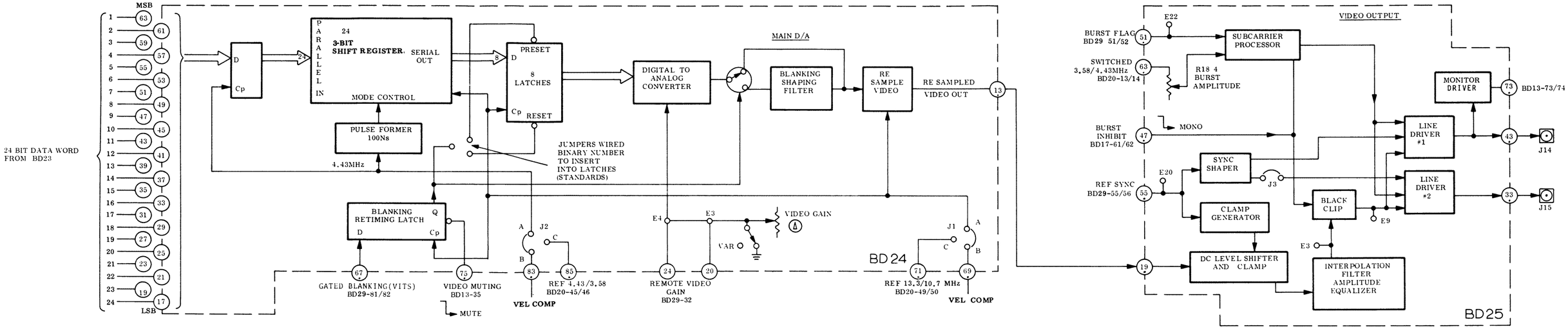
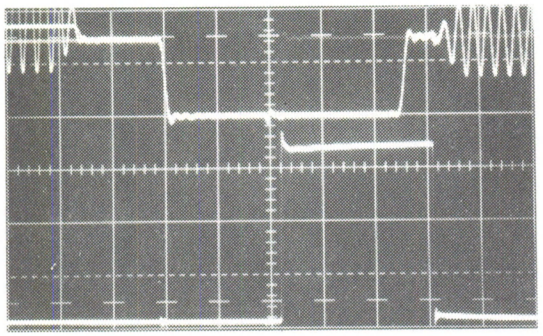



**Figure 3-61. Time Base Corrector Functional Block Diagram (Sheet 3 of 3)**



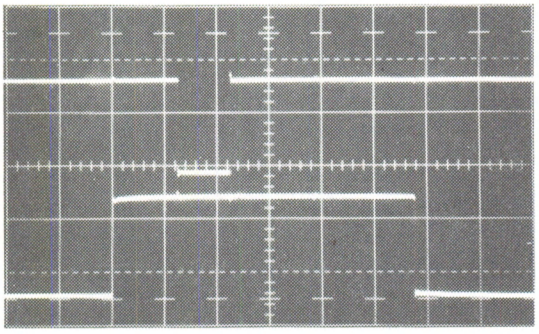
A

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E17 |
| VERTICAL SENSITIVITY: | 2V/CM |
| PROBE: | X 10 |
| TRIGGER: | PIN 35 |
| SWEEP RATE: | 1 μS/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E2 |
| VERTICAL SENSITIVITY: | 0.1 V/CM |
| PROBE: | X10 |



B

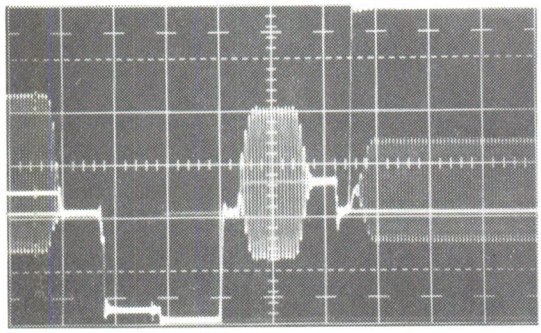
CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E3 |

CHANNEL 2 (LOWER WAVEFORM)

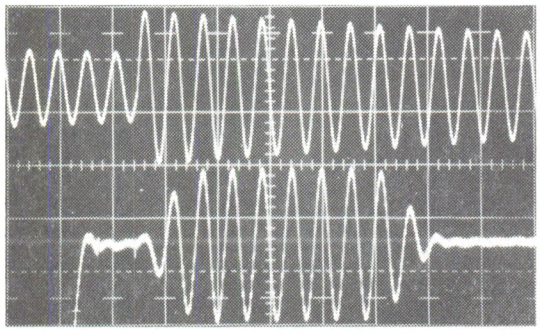
| | |
|---|---|
| TEST POINT: | E5 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X 10 |
| TRIGGER: | PIN 35 |
| SWEEP RATE: | 2 μS/CM |

} BOTH CHANNELS



C

| | |
|---|---|
| TEST POINT: | PIN 83 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X 10 |
| TRIGGER: | PIN 35 |
| SWEEP RATE: | 2 μS/CM |



D

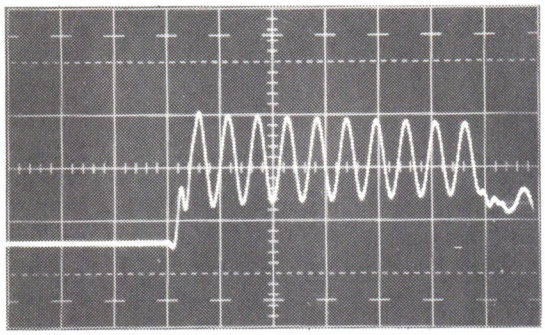
CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E32 |
| VERTICAL SENSITIVITY: | 0.05V/CM (INVERTED) |
| PROBE: | X 10 |
| TRIGGER: | PIN 35 |
| SWEEP RATE: | 0.5 μS/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E17 |
| VERTICAL SENSITIVITY: | 0.01V/CM |
| PROBE: | X 10 |

Figure 3-63. Alignment Waveforms, DTBC Video Input PWA 17, Assembly No. 1374010



E

| | |
|---|---|
| TEST POINT: | PIN 83 |
| VERTICAL SENSITIVITY: | 0.05V/CM |
| PROBE: | X 10 |
| TRIGGER: | E32 |
| SWEEP RATE: | 0.5 μS/CM |

**Figure 3-63. Alignment Waveforms, DTBC Video Input PWA 17, Assembly No. 1374010 (Continued)**

R73 so that the pulse at PWA pin 15 (processed dropout) is 2 μs longer than pulse at PWA 29 (detected dropout).

23. Connect oscilloscope channel 1 probe to tie lug E5.

24. Connect oscilloscope channel 2 probe to tie lug E30. Trigger oscilloscope from tie lug E5.

25. Set jumper J2 to B - C position.

26. Adjust potentiometer R78 (dropout hold) so that pulse at tie lug E30 is coincident in time with pulse at tie lug E5.

27. Replace jumper J2 to A - B position.

CAUTION

STEPS 28 THROUGH 32 COMPRISE THE FACTORY ALIGNMENT PROCEDURE FOR THE LOW PASS FILTER. THIS ALIGNMENT PROCEDURE IS PERFORMED AT THE FACTORY AT THE TIME OF THE PWA's MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD UNLESS THE NEED FOR IT IS CERTAIN AND THE REQUIRED TEST EQUIPMENT IS ACQUIRED.

28. Disconnect mini coax between tie lugs E8 and E16.

29. Connect output of sweep generator to tie lug E17.

30. Connect input of spectrum analyzer to junction of L8, C63 and C64.

31. Adjust inductor L8 for a null at 15.75 MHz, and adjust inductor L9 for a null at 23.75 MHz. Then verify a response of –0.1 dB at 5 MHz, –1 dB±1 dB at 10 MHz, and –60 dB at 15.75 MHz. If necessary, readjust inductors L8 and L9.

32. Reconnect mini coax between tie lugs E8 and E16.

**A/D Converter A PWA 18, Assembly No. 1374254.**

Table 3-23 gives jumper positions for the A/D converter PWA. Align the A/D Converter A PWA 8, Assembly No. 1374254, as follows.

NOTE

**Potentiometers R252 and 254 interact slightly. Repeat steps 1 through 4 until voltage measured at tie lugs E32 and E31 are both to specification.**

**Voltage measurements must be made with a DVM accurate to five places. Use an HP 3400 or equivalent.**

1. Connect DVM to tie lug E32 (see Figure 3-64).

2. Adjust potentiometer R254 for DVM reading of 3.742 Vdc.

3. Connect DVM to tie lug E31.

Table 3-23. Jumper list, A/D Converter A PWA 18, Assembly No. 1374254

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B<br>B - C | NORMAL<br>Ground input to four most significant bit slicers. |

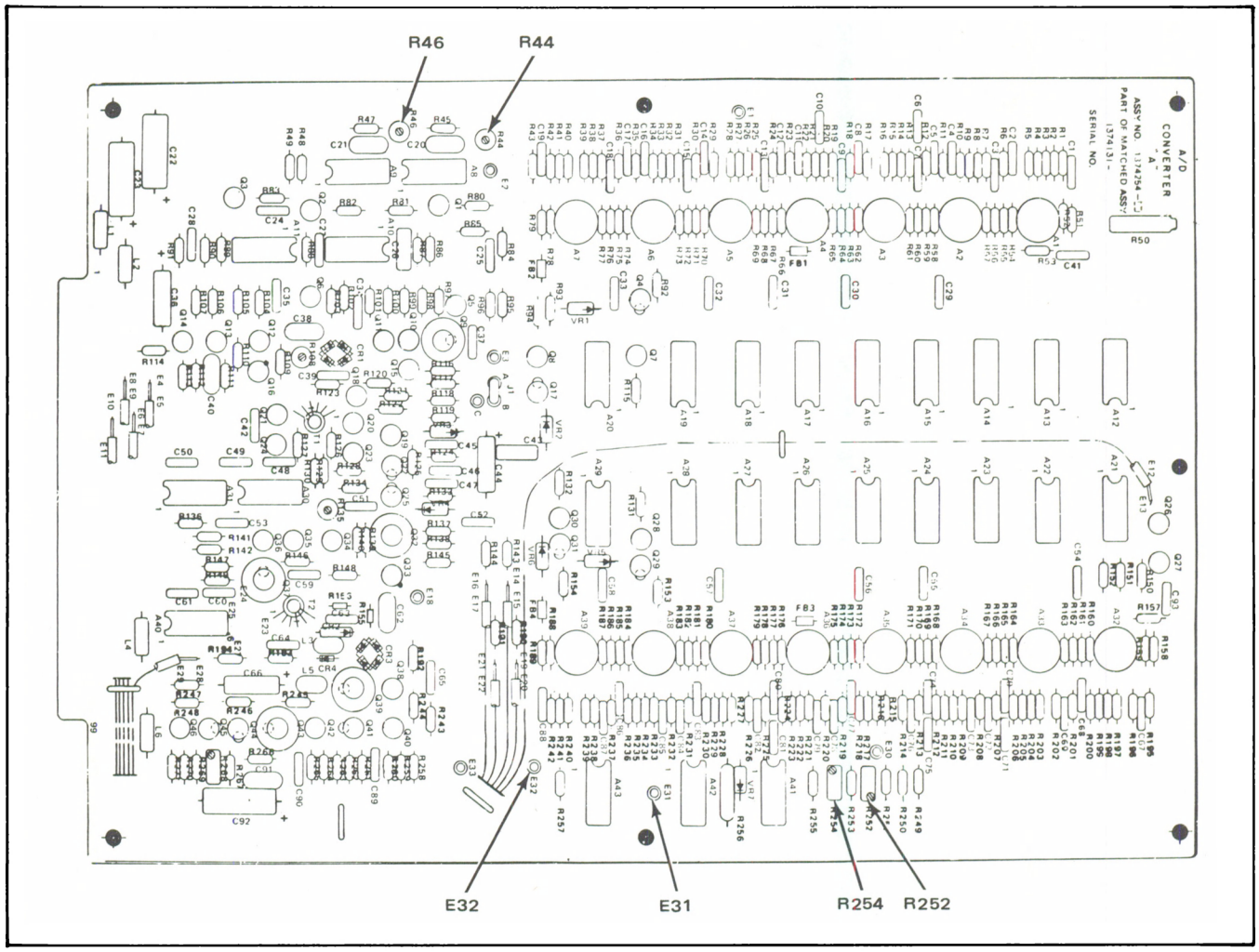



Figure 3-64. A-to-D Converter A PWA 18, Assembly No. 1374254

4. Adjust potentiometer R252 for DVM reading of 1.992 Vdc.

5. Connect DVM to PWA pin 87. DVM reading should be 980 mV ±20 mV.

6. Connect oscilloscope channel 1 probe to PWA pin 13 (clamped sampling positive).

7. Connect oscilloscope channel 2 probe to PWA pin 83 (video input). Trigger oscilloscope from pin 35 (H rate sync).

8. Adjust potentiometer R46 (delay) so that the positive edge of pulse at PWA pin 13 lags the leading edge of the zero reference level pulse at the leading edge of H sync by 250 ns (see Figure 3-65).

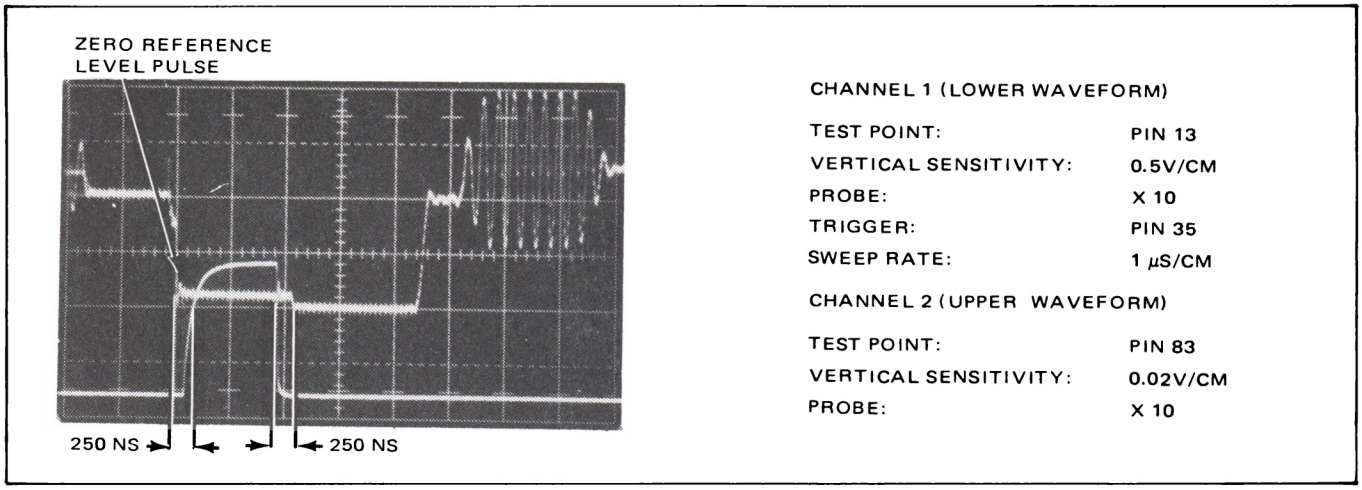



**Figure 3-65. Alignment Waveforms, A-to-D Converter A PWA 18, Assembly No. 1374254**

9. Adjust potentiometer R44 (width) so that the neagative edge of pulse at PWA pin 13 ends 250 ns before the zero reference level pulse ends.

### A/D Converter B PWA 19, Assembly No. 1374257

Table 3-24 gives jumper positions for A/D converter B, PWA 19. Refer to the *DTBC Unity Gain Adjustment Procedure* for alignment of the A/D converter B PWA. Figure 3-66 is provided as an aid to troubleshooting and is obtained as follows:

1. Set jumper J1 on the video input PWA 17 to the B - C position (test ramp enable).
2. Connect oscilloscope channel 1 probe to tie lug E4 on the A/D B PWA 19.
3. Connect oscilloscope channel 2 probe to tie lug E3.

### Clock Generator PWA 20, Assembly No. 1374026

A jumper list for the clock generator PWA is given in Table 3-25. Align the Clock Generator PWA 20, Assembly No. 1374026, as follows:

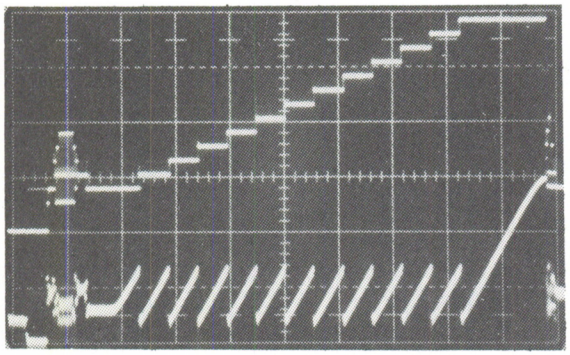
1. Connect oscilloscope channel 1 probe to A9-6 (see Figure 3-67). Set oscilloscope for negative internal triggering.
2. Adjust potentiometer R50 for a 140-ns positive pulse (see Figure 3-68A).
3. Connect oscilloscope channel 1 probe to terminal A of jumper J2.
4. Adjust inductor L5 for maximum 3.58-MHz signal at terminal A of jumper J2.
5. Connect oscilloscope channel 1 probe to A5-1.
6. Adjust potentiometer R7 for a 140 ns positive pulse (see Figure 3-68B).
7. Connect oscilloscope channel 1 probe to tie lug E5.
8. Adjust inductor L3 for maximum 3.58-MHz signal at tie lug E5.
9. Connect oscilloscope channel 1 probe to PWA 20 pin 46/46.
10. Connect oscilloscope channel 2 probe to PWA 20 pin 49/50.
11. Trigger oscilloscope on signal at PWA 20 pin 45/46.
12. Adjust potentiometer R106 so that waveform at A13-8 is symmetrical (see Figure 3-68C).
13. Adjust inductor L18 to position positive edge of pulse at A12-8 in the center of positive pulse at A13-8. Inductor L17 can be used as a fine adjustment for centering waveform (see Figure 3-68C).

Table 3-24. Jumper List, A/D Converter B PWA, Assembly No. 1374257

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B<br>B - C | NORMAL<br>Grounds input to four least significant bit slicers. |

Table 3-25. Jumper List, Clock Generator PWA 20, Assembly No. 1374026

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B<br>B - C | NORMAL – local control subcarrier $\phi$.<br>Remote control subcarrier $\phi$. |
| J2 | A - B<br>B - C | NORMAL<br>Test – for alignment of 3.58-MHz filter. |
| J3 | A - B<br>B - C | NORMAL<br>Test – constant reference 10.7 MHz rather than switched 10.7 MHz. |
| J4 | Removed<br>A - B | NORMAL<br>Grounds input to reference 10.7-MHz filter. |
| J5 | Removed<br>A - B | NORMAL<br>Grounds input to tape 10.7-MHz filter. |
| J6 | A - C<br>A - B | NORMAL<br>Grounds output of tape 3.58-MHz filter. |
| J7 | A - B<br>A - C | NORMAL<br>NORMAL<br>Controls $\phi$ of subcarrier to center range of subcarrier $\phi$ control. |



CHANNEL 1 (UPPER WAVEFORM)

TEST POINT: E4

CHANNEL 2 (LOWER WAVEFORM)

TEST POINT: E3

VERTICAL SENSITIVITY: 0.1V/CM

PROBE: X10

TRIGGER: INTERNAL

SWEEP RATE: 10 µS/CM

} BOTH CHANNELS

Figure 3-66. A/D Converter B PWA, Troubleshooting Waveform

14. Adjust potentiometer R12 on the clock generator PWA 20 to position the burst and chroma vectors to obtain the normal vector relationship. It may be necessary to change jumper J7 from A - B to B - C if insufficient range using potentiometer R12 is encountered.

NOTE

**Potentiometer R12 is used to establish unity chroma phase on velocity compensator 1 PWA. If a velocity compensator is not used, then R12 is the chroma phase adjustment for the time-base corrector.**

## Clock Generator PWA 20, Assembly No. 1374026, Factory Adjustments

### CAUTION

**THE FOLLOWING PROCEDURES ARE FOR ALIGNING THE REFERENCE 3.58-MHz FILTER, THE TAPE 3.38-MHz FILTER, AND THE REFERENCE AND TAPE 10.7-MHz FILTERS. THESE ADJUSTMENTS ARE PERFORMED AT THE FACTORY AT THE TIME OF THE PWA's MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD UNLESS THE NEED FOR IT IS CERTAIN AND THE REQUIRED TEST EQUIPMENT IS ACQUIRED.**

Perform the reference 3.58-MHz filter adjustment as follows:

1. Remove jumper J2 from the PWA.
2. Connect sweep generator to pin B of Jumper J2.
3. Connect spectrum analyzer to tie lug E3.

### NOTE

**Inductors L7 and L12 affect the frequency below 3.58 MHz; inductors L9 and L10 affect the frequency above 3.58 MHz; inductor L8 affects the centering of minimum attenuation.**

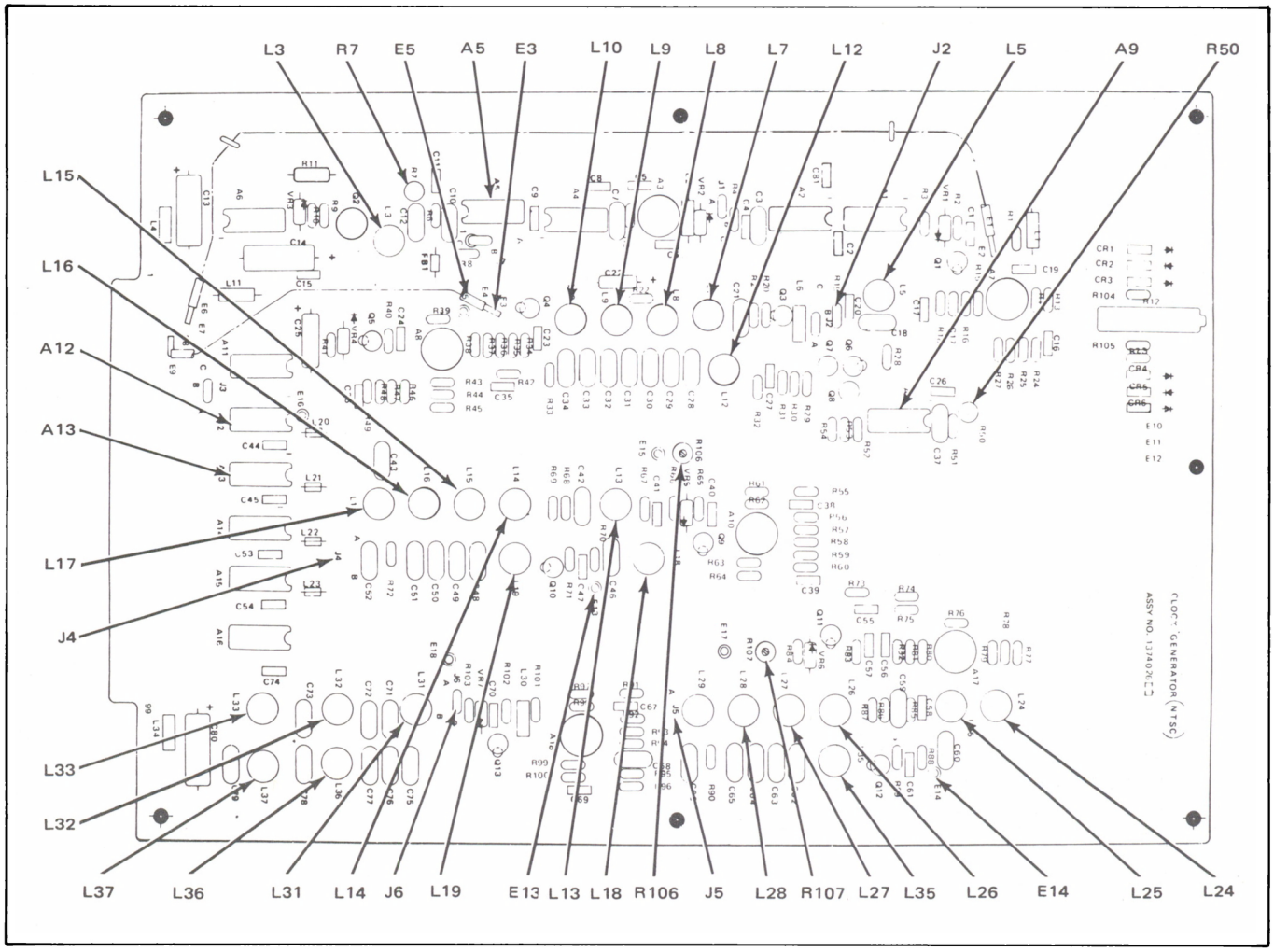
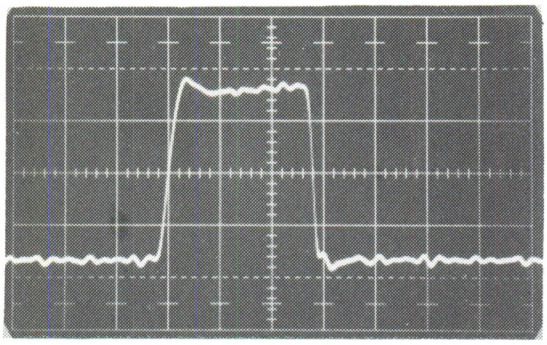


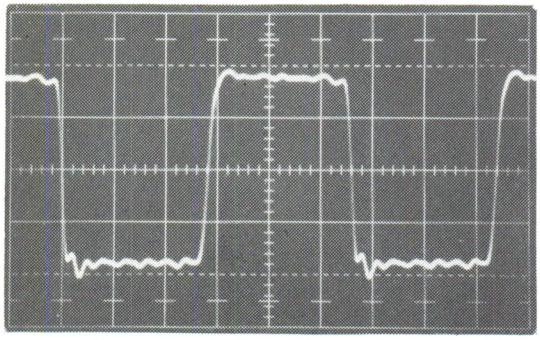

**Figure 3-67. Clock Generator PWA 20, Assembly No. 1374026**



A

CHANNEL 1

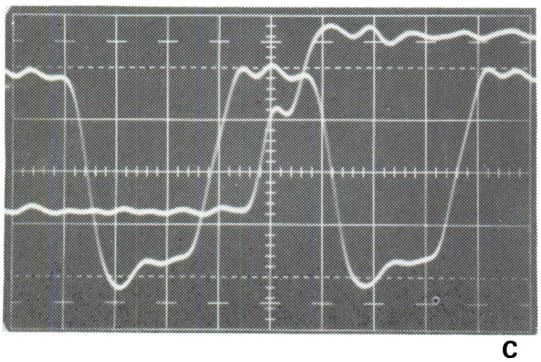
| | |
|---|---|
| TEST POINT: | A9-6 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | INTERNAL, NEGATIVE |
| SWEEP RATE: | 50 NS/CM |



B

CHANNEL 1

| | |
|---|---|
| TEST POINT: | A5-1 |
| VERTICAL SENSITIVITY | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | INTERNAL, NEGATIVE |
| SWEEP RATE: | 50 NS/CM |



C

CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | A12-8 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | A12-8, INTERNAL, NEGATIVE |
| SWEEP RATE: | 20 NS/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | A13-8 |
| VERTICAL SENSITIVITY: | 0.1V/CM |
| PROBE: | X10 |
| TRIGGER: | A12-8, INTERNAL, NEGATIVE |
| SWEEP RATE: | 20 NS/CM |

Figure 3-68. Alignment Waveforms, Clock Generator PWA 20, Assembly No. 1374026

4. Adjust inductors L7, L8, L9, L10, and L12 for a bandpass of –2dB at ±250 kHz of 3.58 MHz.

5. Reinsert jumper J2 in B - C position.

Perform the tape 3.58-MHz filter adjustment as follows:

1. Remove the burst store generator PWA 21.

2. Connect sweep generator to PWA 20 pin 87.

3. Connect spectrum analyzer to pin C of jumper J6.

NOTE

**Inductors L31 and L32 affect frequency above 3.58 MHz; L33 and L37 affect frequency below 3.58 MHz; L36 affects the centering of minimum attenuation.**

4. Adjust inductors L31, L32, L33, L36 and L37 for a bandpass of –2 dB at ±250 kHz of 3.58 MHz.

5. Reinstall the burst store generator PWA 21.

Perform the reference 10.7-MHz filter adjustment as follows:

1. Connect sweep generator to pin A of jumper J4.

2. Connect spectrum analyzer to tie lug E13.

3. Place jumper J2 in B - C position.

4. Adjust inductor L13 for maximum 10.7-MHz signal amplitude.

5. Adjust inductor L16 for null at 17.9 MHz (30 dB down from 10.7 MHz).

6. Adjust inductor L15 for null at 14.3 MHz (30 dB down from 10.7 MHz).

7. Adjust inductor L19 for a null at 7.16 MHz (30 dB down from 10.7 MHz).

8. Adjust inductor L14 for a null at 3.58 MHz (40 dB down from 10.7 MHz).

9. Replace jumper J2 in A - B position.

Perform the tape 10.7-MHz filter adjustment as follows:

1. Connect sweep generator to pin B of jumper J5.

2. Place jumper J6 in B - C position.

3. Connect spectrum analyzer to tie lug E14.

4. Adjust inductor L25 for maximum 10.7-MHz signal amplitude.

5. Adjust inductor L28 for null at 17.9 MHz (30 dB down from 10.7 MHz).

6. Adjust inductor L27 for null at 14.3 MHz (30 dB down from 10.7 MHz).

7. Adjust inductor L35 for null at 7.16 MHz (30 dB down from 10.7 MHz).

8. Adjust inductor L26 for null at 3.58 MHz (40 dB down from 10.7 MHz).

9. Reinstall jumper J6 to A - C position.

10. Remove sweep generator from pin B of jumper J5.

11. Connect spectrum analyzer to PWA pin 61.

12. Adjust inductors L24 and L29 for minimum signal at 3.58 MHz and 17.9 MHz (55 dB down from 10.7 MHz).

**Burst Store Generator PWA 21, Assembly No. 1374042**

Table 3-26 is a jumper list for the burst store generator PWA. Align the Burst Store Generator PWA 21, Assembly No. 1374042, as follows:

1. Connect oscilloscope channel 1 probe to tie lug E1 (see Figure 3-69).

Table 3-26. Jumper List, Burst Store Generator PWA 21, Assembly No. 1374042

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | B - C | NORMAL |
| | A - B | Test – allows complete line of input data to be processed through D - A. |
| J2 | A - B | NORMAL |
| | B - C | Test – allows complete line of input data to be processed through D - A. |
| J3 | A - B | NORMAL |
| | Removed | Removes reference to constant current source. |

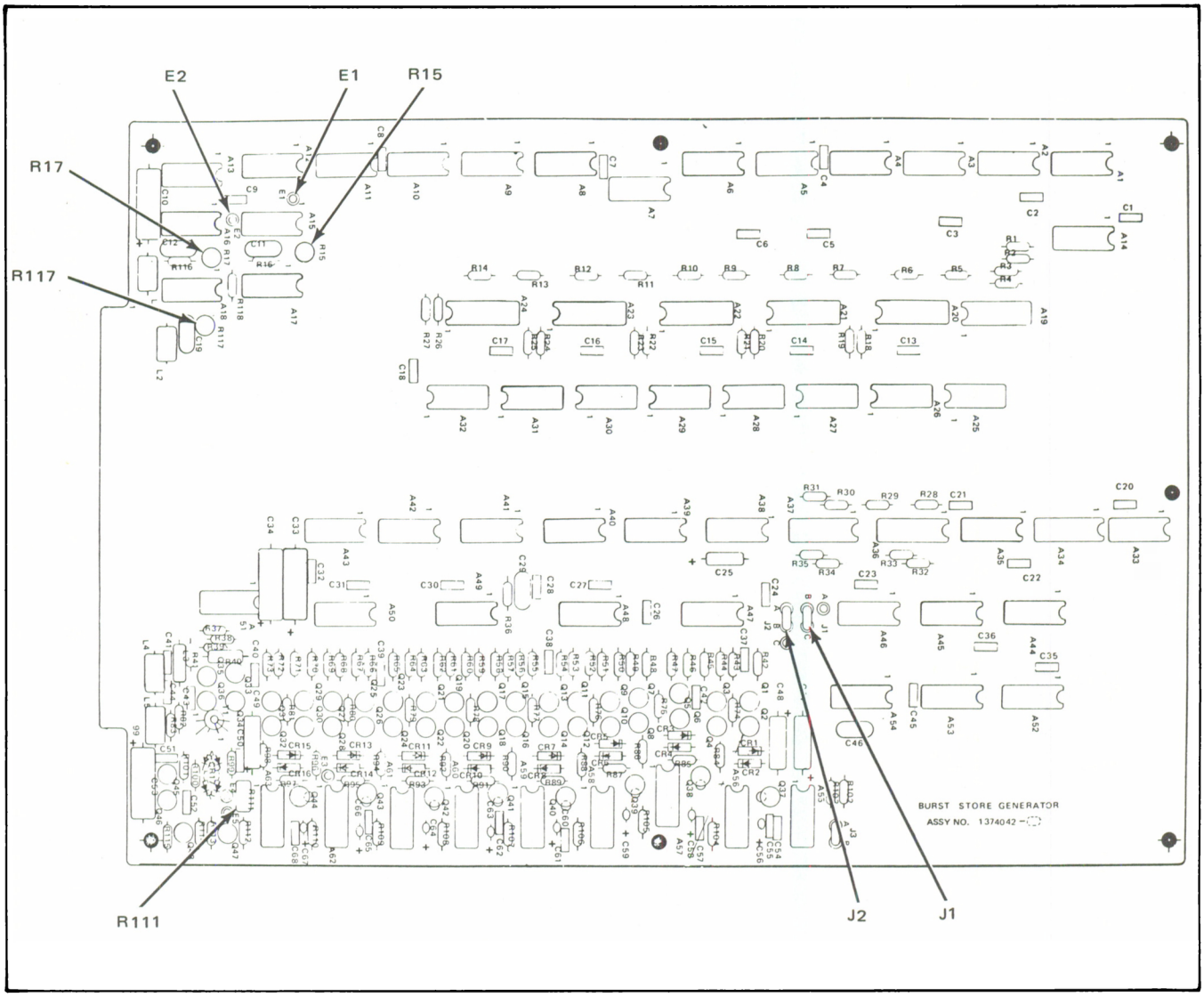



Figure 3-69. Burst Store Generator PWA 21, Assembly No. 1374042

2. Set oscilloscope to trigger internally, negative slope.

3. Adjust potentiometer R15 for a negative pulse of 42 ±5 ns.

4. Connect oscilloscope channel 1 probe to tie lug E2. Trigger from PWA pin 14.

5. Adjust SUBC PHASE potentiometer on the front of the clock generator PWA for a jittering pulse at tie lug E2 (negative transition of pulse will be stable but the positive transition will switch between two points). See Figure 3-70.

NOTE

**Potentiometers R17 and R117 interact slightly. Repeat steps 6 and 7 until timings are correct.**

6. Adjust R117 until narrow pulse width is 75 ns.

7. Adjust R17 until wide pulse width is 150 ns.

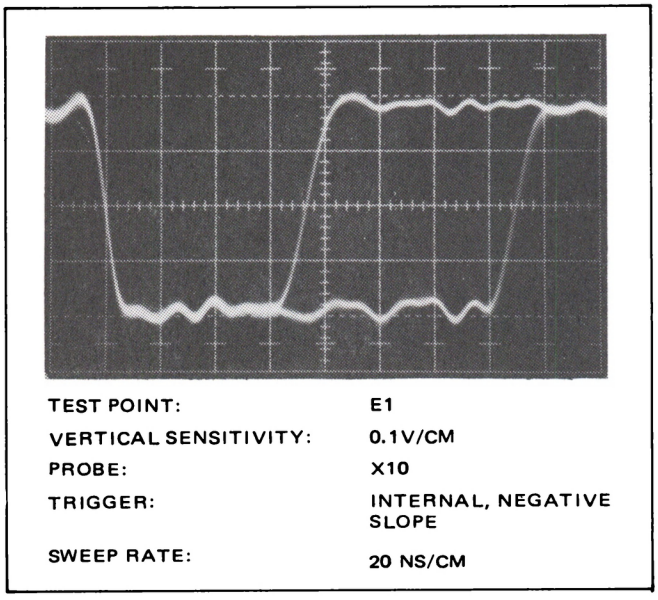



**Figure 3-70. Alignment Waveform, Burst Store Generator PWA 21, Assembly No. 1374042**

NOTE

**Steps 8 through 14 are a factory adjustment and should not be performed as a routine alignment.**

8. Verify that A/D converter A PWA 18 and A/D converter B PWA 19 have been properly adjusted in accordance with the *DTBC Unity Gain Procedure,* steps 1 through 5.

9. Set jumper J1 on video input PWA 17 to B - C position to enable the test ramp.

10. Set jumper J3 on the clock generator PWA 20 to B - C position (reference 10.7 MHz).

11. On the burst store generator PWA 21 set jumper J1 to the A - B position and jumper J2 to the B - C position.

12. Connect oscilloscope channel 1 probe to PWA 21 pin 87. Trigger from PWA 87.

13. Adjust potentiometer R111 for a linear ramp at PWA 21 pin 87. Eliminate any bumps or steps at the midpoint of the ramp.

14. Replace video input PWA 17 jumper J1, clock generator PWA 20 jumper J3, and burst store generator PWA 21 jumpers J1 and J2 to their normal operating positions.

**256-Word Memory PWA 22, Assembly No. 1374050**

Align the 256 Word Memory PWA 22, Assembly No. 1374050, as follows:

1. Connect oscilloscope channel 1 to A37-13 (see Figure 3-71).

2. Connect oscilloscope channel 2 to A37-1.

3. Trigger oscilloscope from A37-1.

4. Adjust potentiometer R32 so that the positive edge of the pulse at A37-1 is coincident with the positive edge of the pulse at A37-13 (see Figure 3-72).

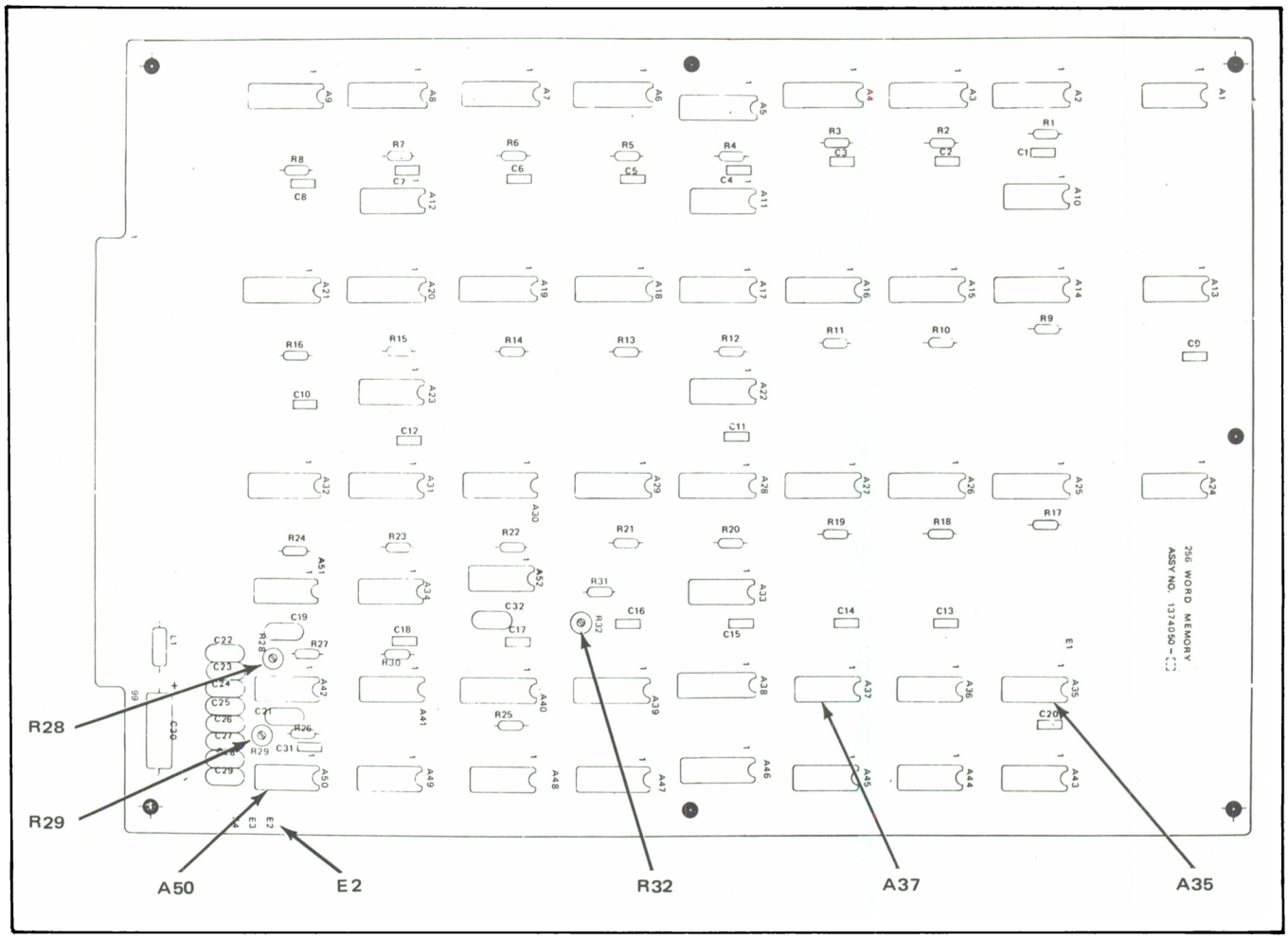



**Figure 3-71. 256 Word Memory PWA 22, Assembly No. 1374050**

5. Connect oscilloscope channel 1 to tie lug E2 (A50-9).

6. Connect oscilloscope channel 2 to A35-6.

7. Trigger oscilloscope from positive slope of signal at tie lug E2.

8. Adjust potentiometer R29 for a pulse width of 60 ns at A35-6 (see Figure 3-72B).

9. Adjust potentiometer R28 so that the negative edge of the pulse at A35-6 starts 60 ns after the negative edge of the pulse at E2 (see Figure 3-72B).

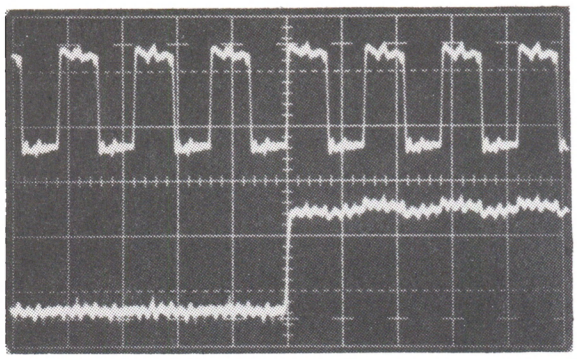
**Two-Line Delay (NTSC) PWA 23, Assembly No. 1374058**

Table 3-27 is a jumper list for the two-line delay PWA. Align the Two-Line Delay PWA 23, Assembly No. 1374058, as follows:

1. Connect the oscilloscope in sequence to tie points E1, E2, E3 and E4 (see Figure 3-73). All pulse widths should be within 15 ns of each other.

2. Adjust potentiometer R96 so that the narrowest pulse width is 130 ns.

3. Connect oscilloscope channel 1 probe to pin 15.



CHANNEL 1 (UPPER WAVEFORM)

TEST POINT: A37-13

CHANNEL 2 (LOWER WAVEFORM)

TEST POINT: A37-1

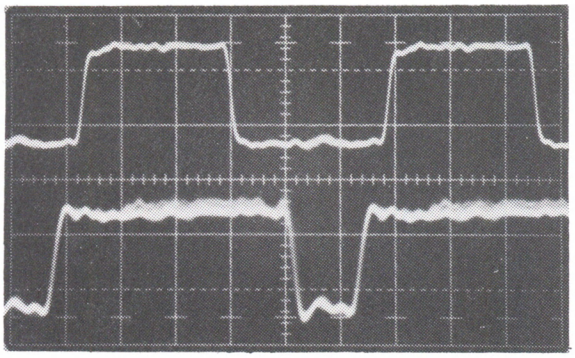
VERTICAL SENSITIVITY: 0.2V/CM

PROBE: X10

TRIGGER: A37-1

SWEEP RATE: 0.2 μS/CM

} BOTH CHANNELS



CHANNEL 1 (UPPER WAVEFORM)

TEST POINT: E2

CHANNEL 2 (LOWER WAVEFORM)

TEST POINT: A35-6

VERTICAL SENSITIVITY: 0.2V/CM

PROBE: X10

TRIGGER: E2, POSITIVE SLOPE

SWEEP RATE: 50 NS/CM

} BOTH CHANNELS

**Figure 3-72. Alignment Waveforms, 256 Word Memory PWA 22, Assembly No. 1374050**

**Table 3-27. Jumper List, Two-Line Delay PWA 23, Assembly No. 1374058**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL |
| | Removed | Remove for factory test (prevents program counter No. 1 from being reset). |
| J2 | A - B | NORMAL |
| | Removed | Remove for factory test (allows program counter no. 1 to count continuously). |
| J3 | A - B | NORMAL |
| | Removed | Remove for factory test (allows program counter no. 2 to count continuously). |

4. Connect oscilloscope channel 2 probe to PWA tie lug E1. Trigger scope from channel 2.

5. Adjust potentiometer R94 so that the positive edge of the pulse on channel 1 leads the negative edge of the pulse on channel 2 by 150 ns (see Figure 3-74A).

### Main D/A PWA 24, Assembly No. 1374066

Table 3-28 is a jumper list for the main D/A PWA. Align the Main D/A PWA, Assembly No. 1374066, as follows.

1. Supply the AVR-2 with a flat field zero % APL test signal.

2. Connect oscilloscope channel 1 probe to PWA pin 13. Trigger oscilloscope from PWA pin 67.

3. Adjust potentiometer R68 (see Figure 3-75) for no step in the video at blanking.

4. Supply the AVR-2 with a flat field 50% APL test signal.

5. Adjust potentiometer R41 and inductors L1 and L2 for smoothest transition from

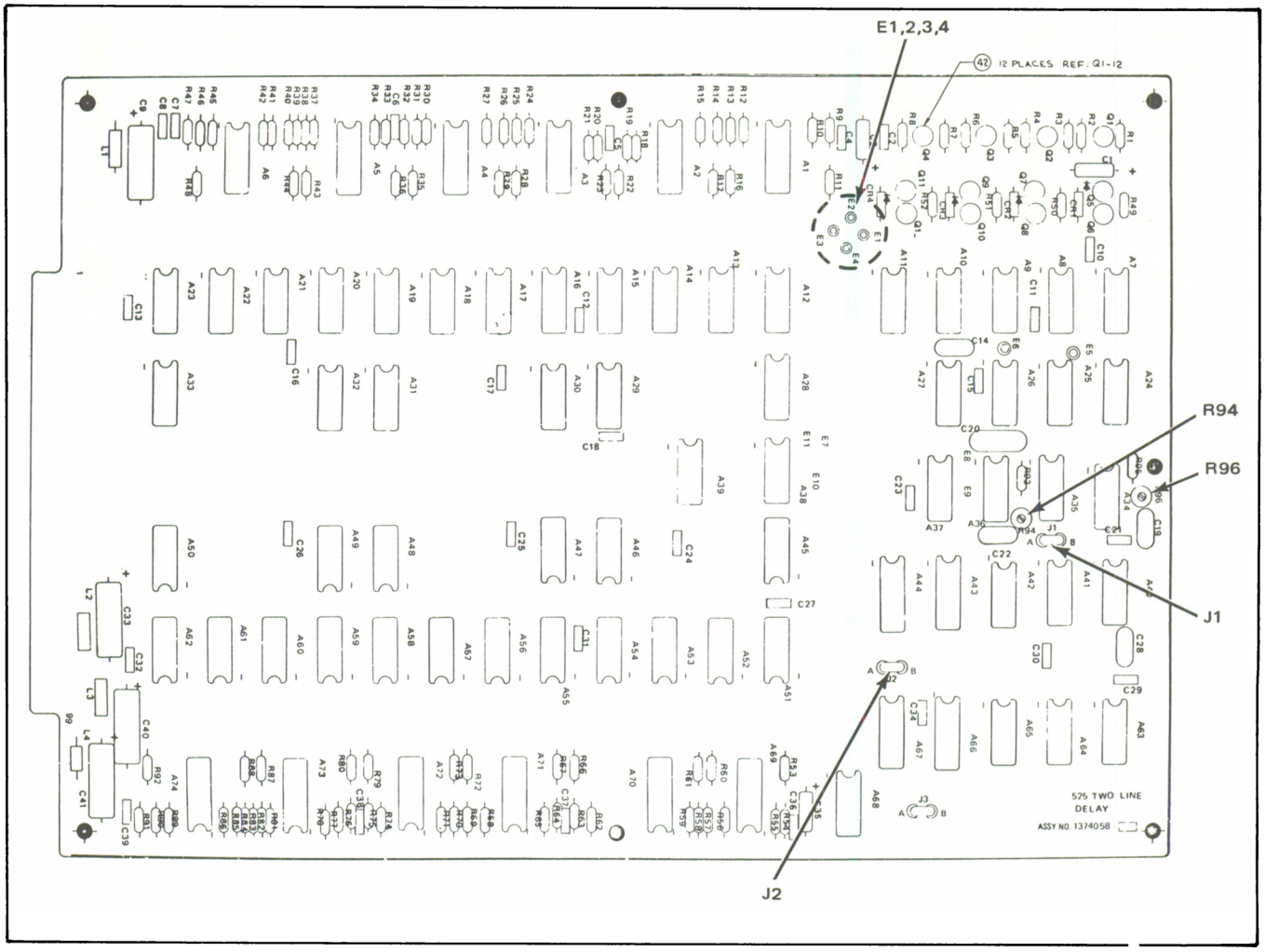



**Figure 3-73. Two-Line Delay PWA 23, Assembly No. 1374058**

blanking to the 50% APL with no overshoots or steps (see Figure 3-76).

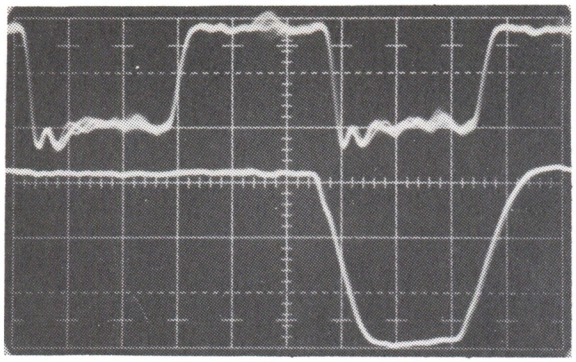
NOTE

**Additional adjustments are given in the** *DTBC Unity Gain Procedure.*

**Video Output PWA 25, Assembly No. 1374070**

Refer to Table 3-29 for the jumper list for PWA 25. Align the Video Output PWA, Assembly No. 1374070 as follows:

1. Terminate the VIDEO OUT-1 connector on the rear panel of the AVR-2 into 75 ohms.
2. Connect oscilloscope channel 1 probe to PWA 25 pin 43. Trigger oscilloscope from PWA 25 pin 55.
3. Adjust potentiometer R184 (see Figure 3-77) so that the burst amplitude is 286 mV (40 IEEE units).
4. Adjust potentiometer R119 so that burst is symmetrical around blanking.
5. Connect oscilloscope channel 1 to terminated VIDEO OUT-1 connector.
6. Set scope gain to 0.01 V/cm.

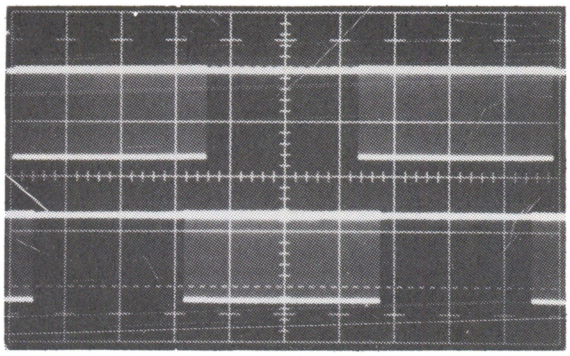


CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | PIN 15 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |
| TRIGGER: | TIE LUG E1 |
| SWEEP RATE: | 50 NS/CM |

CHANNEL 2 (LOWER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E1 |
| VERTICAL SENSITIVITY: | 0.5V/CM |
| PROBE: | X10 |



CHANNEL 1 (UPPER WAVEFORM)

| | |
|---|---|
| TEST POINT: | E1 |

CHANNEL 2 (LOWER WAVEFORM)

| | | |
|---|---|---|
| TEST POINT: | E2 | |
| VERTICAL SENSITIVITY: | 1V/CM | BOTH CHANNELS |
| PROBE: | X10 | |
| TRIGGER: | PWA PIN 70 | |
| SWEEP RATE: | 20 μS/CM | |

**Figure 3-74. Alignment Waveforms, Two-Line Delay PWA 23, Assembly No. 1374058**

**Table 3-28. Jumper List, Main D/A PWA, Assembly No. 1374066**

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL – With velocity compensator. |
| | A - C | NORMAL – Without velocity compensator. |
| J2 | A - B | NORMAL – With velocity compensator. |
| | A - C | NORMAL – Without velocity compensator. |

7. Press DEMOD OUT button on the monitor panel.

8. Adjust the scope to position the blanking level of the observed signal to the center graticule.

9. Press the VID OUT button and adjust potentiometer R132 on the video output PWA to center the blanking level at the center of the graticule of the scope.

10. Remove the extender and reinsert video output PWA 25 into the recorder. Recheck burst level after video output PWA has been reinserted into the recorder to make certain level has not changed. See step 3.

11. Supply AVR-2 with modulated ramp with zero % setup.

12. Connect vectorscope to video output.

13. Set vectorscope to measure D.G.

14. Adjust potentiometer R56 for the best D.G. below blanking level.

15. Set vectorscope to measure D.$\phi$.

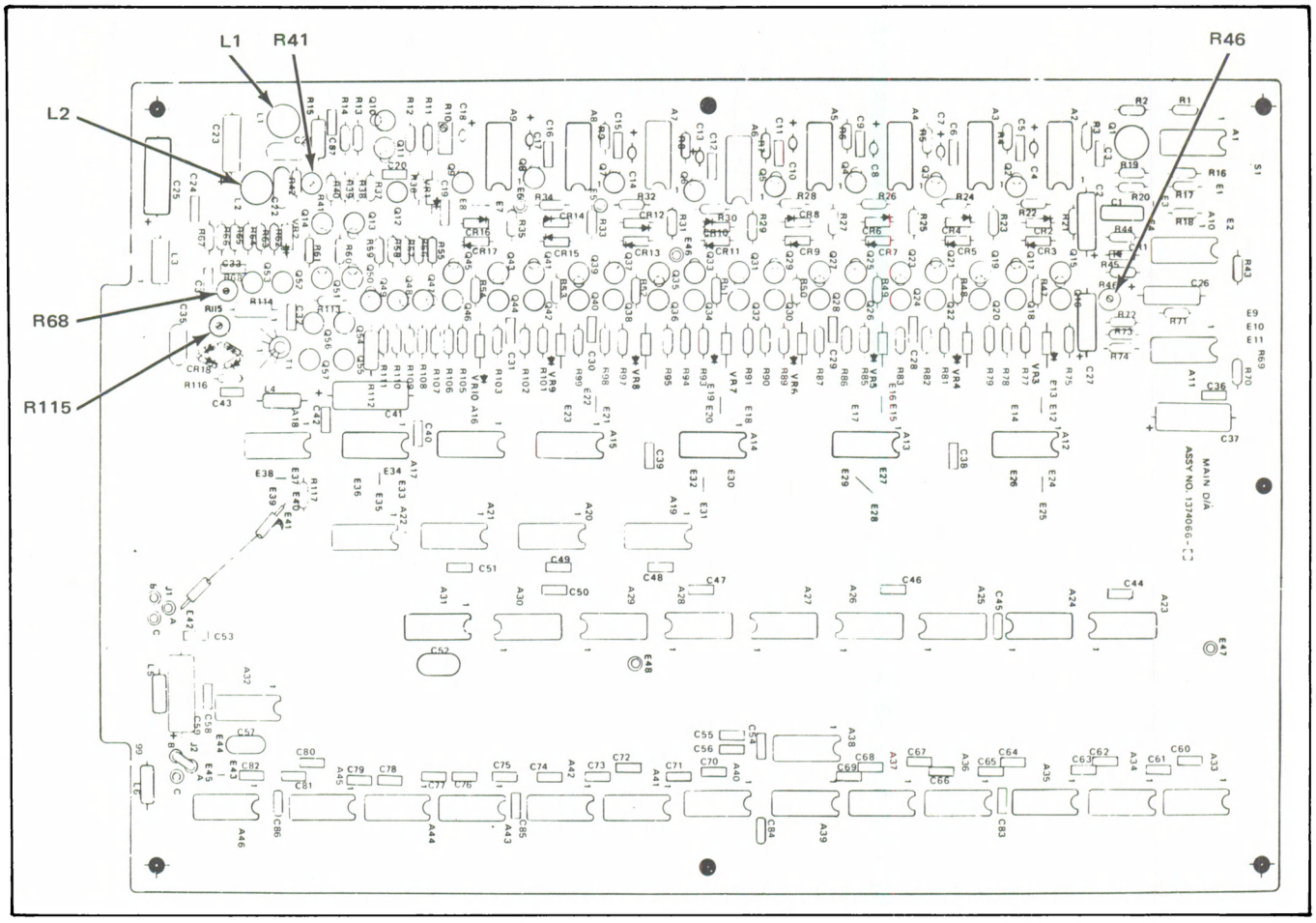
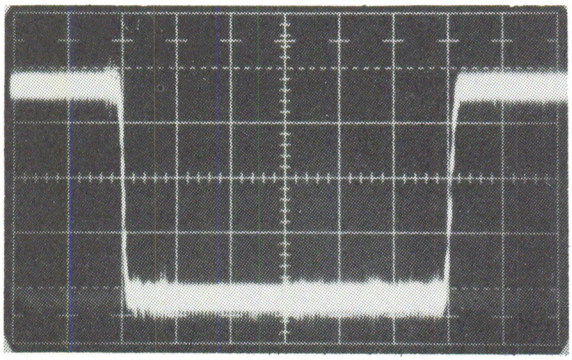



Figure 3-75. Main D/A PWA 24, Assembly No. 1374066



| | |
|---|---|
| TEST POINT: | PIN 13 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |
| TRIGGER: | PIN 67 |
| SWEEP RATE: | 2 μS/CM |

Figure 3-76. Alignment Waveform, D/A PWA 24, Assembly No. 1374050

16. Adjust inductor L4 for the best D.$\phi$. below blanking level.

**CAUTION**

**THE INTERPOLATION FILTER ALIGNMENT IS PERFORMED AT THE FACTORY AT THE TIME OF THE VIDEO OUTPUT PWA's MANUFACTURE AND SHOULD NOT BE PERFORMED IN THE FIELD. THE FOLLOWING INFORMATION ON THE INTERPOLATION FILTER IS GIVEN FOR REFERENCE ONLY.**

The interpolation filter is aligned for a response of ±0.1 dB from 100 kHz to 3.58 MHz; ±0.15 dB to 4.2 MHz, and ±0.3 dB to 5.0 MHz with no more than 0.1 dB ripple from 100 kHz to 5 MHz.

Table 3-29. Jumper List, Video Output PWA 25, Assembly No. 1374070

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B | NORMAL |
| | Removed | Removed for factory test (removes amplitude equalizer RC networks). |
| J2 | A - B | NORMAL |
| | Removed | Removed for factory test (disconnects dc level shift reference). |
| J3 | A - C | NORMAL – Composite video at VIDEO OUT 2. |
| | B - C | Non-composite video at VIDEO OUT 2. |

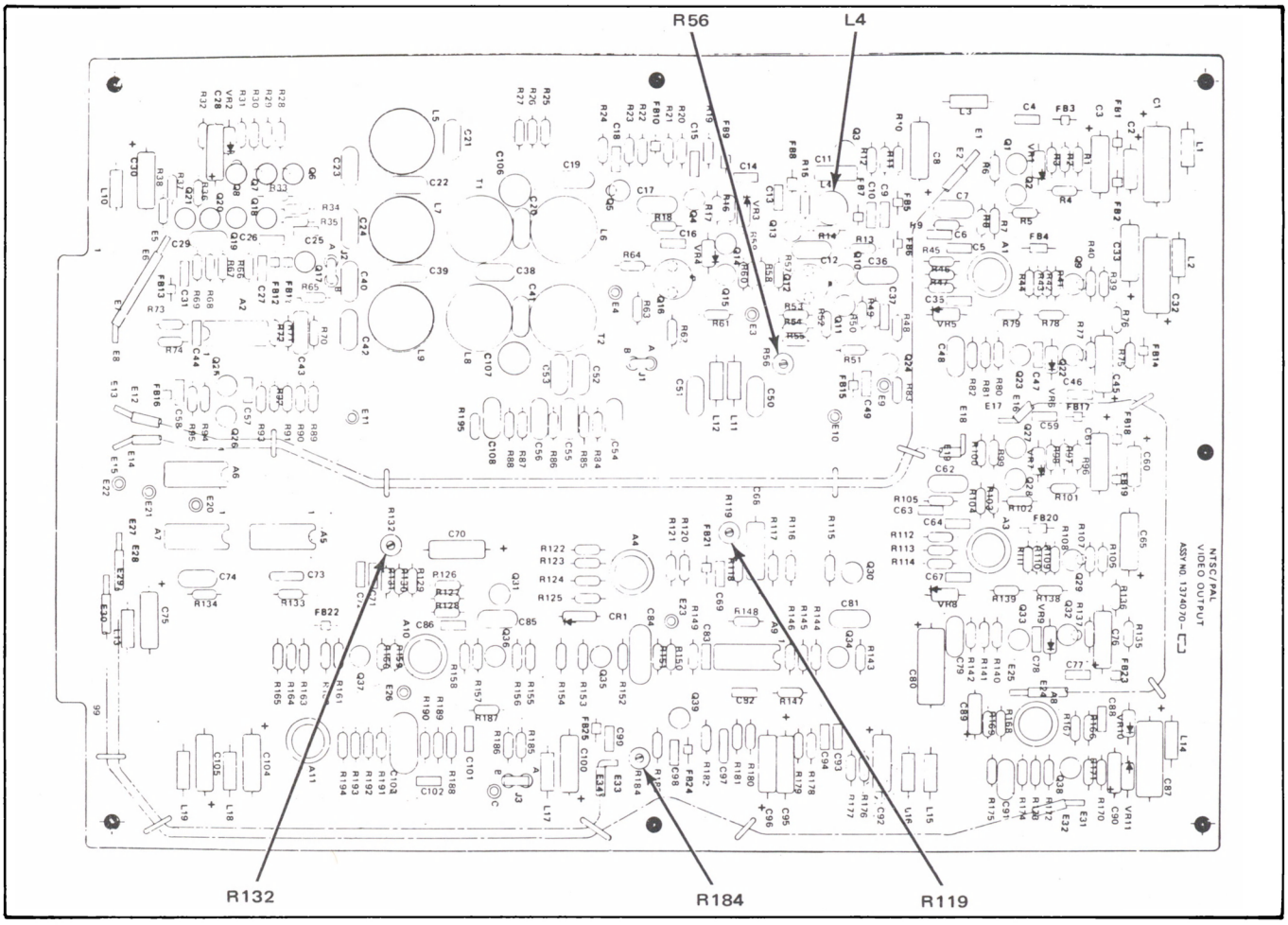



Figure 3-77. Video Output PWA 25, Assembly No. 1374070

## Logic (NTSC) PWA 28, Assembly No. 1374278

Table 3-30 is a jumper list for PWA 28. Align the Logic PWA 28, Assembly No. 1374278, as follows:

1. Connect oscilloscope channel 1 probe to A7-6 (see Figure 3-78).
2. Trigger oscilloscope from PWA 28 pin 39.
3. Adjust potentiometer R58 for a symmetrical pulse at 3.58-MHz rate.
4. Connect oscilloscope channel 1 probe to PWA 28 pin 39.

Table 3-30. Jumper List, Logic PWA 28, Assembly No. 1374278

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | Removed | NORMAL |
| | A - B | (Disables) recentering circuit. |
| J2 | Removed | NORMAL |
| | A - B | (Disables) horizontal correction circuit. |
| J3 | Removed | NORMAL |
| | A - B | Provides memory test cycling at 1-second rate. |
| | B - D | Provides memory test cycling at ½-second rate. |
| | B - C | Provides memory test cycling at ¼-second rate. |
| J4 | A - B | NORMAL |
| | Removed | Memory test function. |
| J5 | A - B | NORMAL |
| | Removed | Memory test function. |
| **NOTE** | | |
| **J3, J4 and J5 used in conjunction with memory test.** | | |

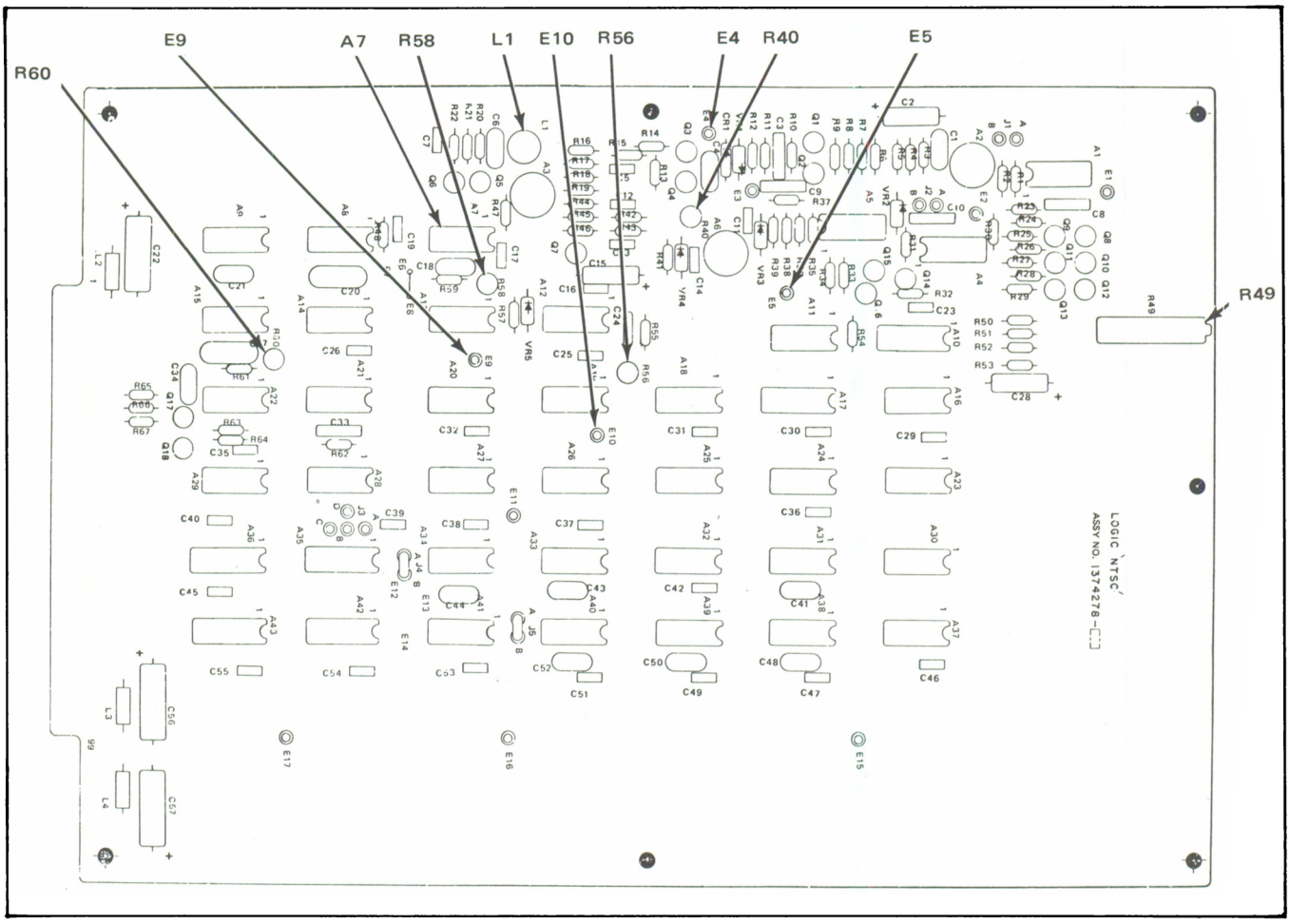



Figure 3-78. Logic PWA 28, Assembly No. 1374278

5. Connect oscilloscope channel 2 probe to tie lug E10.

6. Adjust inductor L1 for stable and uniform amplitude of signal at tie lug E10 (8X subcarrier).

7. Repeat steps 1 through 3. Slight readjustment of potentiometer R48 may be necessary.

8. Repeat steps 4 and 5.

9. Verify that there are eight cycles of signal at E10 compared to one cycle of signal at PWA pin 39 (see Figure 3-79A).

10. Connect oscilloscope channel 1 probe to A12 (tie lug E5).

11. Set oscilloscope for positive internal triggering.

12. Adjust potentiometer R56 for a 50-$\mu$s positive pulse.

13. Connect oscilloscope channel 1 probe to tie lug E4.

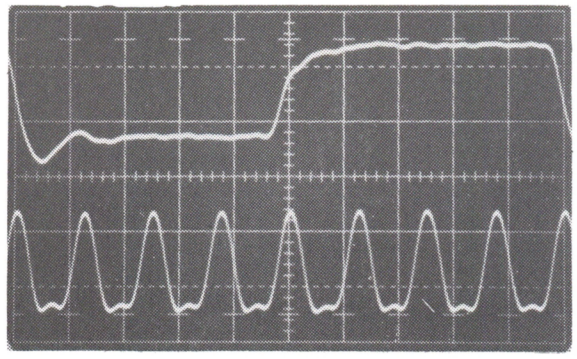
14. Set the oscilloscope for negative internal triggering.

15. Adjust potentiometer R40 for a positive going ramp with duration of 400 ns (see Figure 3-79B).

16. Connect oscilloscope channel 1 probe to tie lug E9.

17. Set oscilloscope to trigger internal positive.

18. Adjust potentiometer R60 for an 8.6-$\mu$s positive pulse.



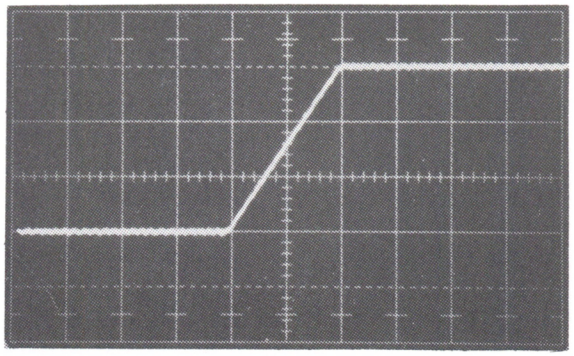
A

UPPER WAVEFORM

| | |
|---|---|
| TEST POINT: | PIN 39 |

LOWER WAVEFORM

| | | |
|---|---|---|
| TEST POINT: | E10 | |
| VERTICAL SENSITIVITY: | 0.2V/CM | BOTH CHANNELS |
| PROBE: | X10 | |
| TRIGGER: | PIN 39 | |
| SWEEP RATE: | 20 NS/CM | |



B

| | |
|---|---|
| TEST POINT: | E4 |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X10 |
| TRIGGER: | INTERNAL, NEGATIVE |
| SWEEP RATE: | 0.2 $\mu$S/CM |

**Figure 3-79. Alignment Waveforms, Logic PWA 28, Assembly No. 1374278**

19. Install a T adapter on connector J13 (VIDEO IN) and J14 (VIDEO OUT-1) on the rear connector panel of the AVR-2.

20. Connect oscilloscope channel 1 probe to J13 and channel 2 probe to J14.

21. Remove jumper J13 on the sync generator PWA 30 and adjust the HORIZ PHASE control on the front of the sync generator PWA 30 to bring the leading edges of input and output H sync into coincidence.

22. Connect a vectorscope with channel 1 to J13 (VIDEO IN) and channel 2 to J14 (VIDEO OUT).

23. Trigger the vectorscope with reference subcarrier.

24. Adjust SUBC PHASE control on clock generator PWA 20 so that the two signals on the vectorscope coincide.

25. Remove the vectorscope.

26. Connect oscilloscope channel 1 probe to J13 (VIDEO INPUT) and channel 2 probe to J14 (VIDEO OUT).

27. Trigger oscilloscope from channel 1.

28. Adjust potentiometer R49 on logic PWA 28 (through front panel of the PWA) so that the leading edge of the white window is coincident on the two channels, and there is no ringing.

29. Remove the T adapters and test equipment; reinstall jumper J13 in sync generator PWA 30.

**DTBC Unity Gain Adjustment Procedure (NTSC)**

Before performing this procedure, the signal system must be accurately adjusted for unity gain. When comparing video input signals to video output signals, use cables of equal length from the AVR-2 to the oscilloscope. Ensure oscilloscope is properly calibrated. Terminate the cables in 75-ohm, 1/4% tolerance, termination resistors.

Perform the DTBC unity gain adjustment procedure (NTSC) as follows:

1. Supply color bars with zero % setup to the video input of the AVR-2.

2. Place jumper J1 on the video input PWA 17 in B - C position (test ramp enable).

3. Place A/D converter B PWA 19 on an extender board.

4. Connect channel 1 of oscilloscope to connector J14 (VIDEO OUT-1) on the rear panel of the AVR-2.

5. Adjust potentiometer R50 through the front of the A/D converter A PWA 18 and potentiometers R100, R109, R119, and R248 on the A/D converter B PWA 19 to produce the cleanest, most linear ramp possible, with no steps, spikes or bumps. Figures 3-80 through 3-84 indicate the effect on the output waveform of each of the potentiometers.

6. Replace jumper J1 on video input PWA 17 to the A - B position.

7. Change the test signal supplied to the AVR-2 to an unmodulated ramp with zero % setup. Assure that signal is 1 volt from peak white to sync tip.

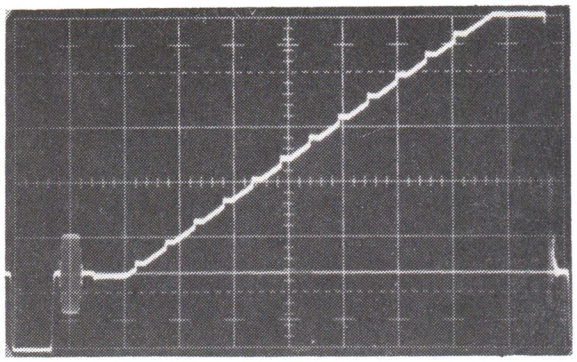
8. Connect oscilloscope channel 1 probe to video input PWA 17, pin 17.

9. Adjust gain of oscilloscope to display 1 volt video equal to 4 cm on the oscilloscope graticule.

10. Adjust VIDEO GAIN potentiometer on modulator PWA 12 for level of 5.2 cm.

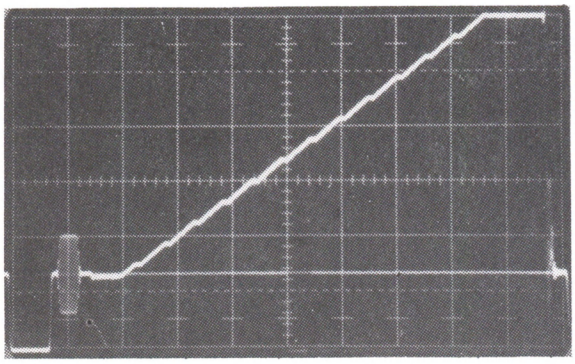
11. Connect oscilloscope channel 2 probe to connector J14 VIDEO OUT-1 on the rear connector panel.

12. Observe black level of VIDEO OUT signal. If black level varies as input level is increased, adjust BLACK LEVEL potentiometer on video input PWA 17 for original setup level.



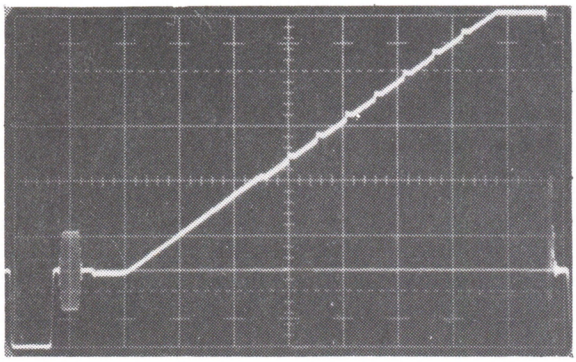
| | |
|---|---|
| TEST POINT: | VIDEO OUT (REAR CONNECTOR PANEL) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X1 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 5 μS/CM, UNCALIBRATED |

Figure 3-80. DTBC Unity Gain, Effect of Potentiometer R50 Misadjustment on Test Ramp



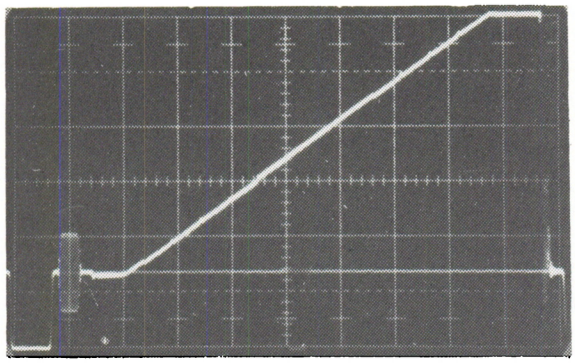
| | |
|---|---|
| TEST POINT: | VIDEO OUT (REAR CONNECTOR PANEL) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X1 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 5 μS/CM, UNCALIBRATED |

Figure 3-81. DTBC Unity Gain, Effect of Potentiometer R100 Misadjustment on Test Ramp



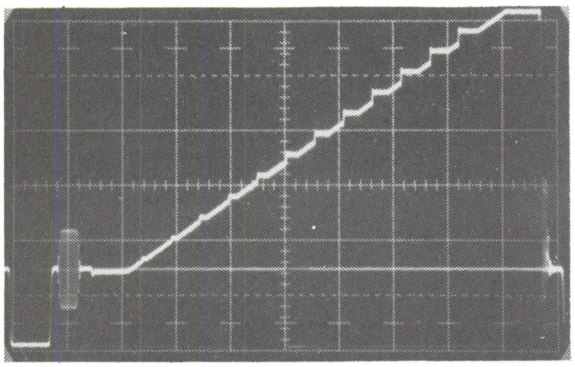
| | |
|---|---|
| TEST POINT: | VIDEO OUT (REAR CONNECTOR PANEL) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X1 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 5 μS/CM, UNCALIBRATED |

Figure 3-82. DTBC Unity Gain, Effect of Potentiometer R109 Misadjustment on Test Ramp



| | |
|---|---|
| TEST POINT: | VIDEO OUT (REAR CONNECTOR PANEL) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X1 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 5 μS/CM, UNCALIBRATED |

**Figure 3-83. DTBC Unity Gain, Effect of Potentiometer R119 Misadjustment on Test Ramp**



| | |
|---|---|
| TEST POINT: | VIDEO OUT (REAR CONNECTOR PANEL) |
| VERTICAL SENSITIVITY: | 0.2V/CM |
| PROBE: | X1 |
| TRIGGER: | INTERNAL |
| SWEEP RATE: | 5 μS/CM, UNCALIBRATED |

**Figure 3-84. DTBC Unity Gain, Effect of Potentiometer R248 Misadjustment on Test Ramp**

13. On A/D converter A PWA 18, adjust potentiometer R268 so that the video just begins to clip at peak white.

14. If the black level has changed, readjust the BLACK LEVEL potentiometer and potentiometer R268 for proper clipping operation.

15. Return the VIDEO GAIN switch on modulator PWA 12 to UNITY.

16. Return the BLACK LEVEL switch on video input PWA 17 to UNITY.

17. Return calibration of oscilloscope to calibrate.

18. Change the input video back to color bars and connect oscilloscope channel 1 probe to VIDEO INPUT (J13) connector on rear connector panel. Channel 2 probe remains the same.

19. Remove jumper J13 from sync generator PWA 29.

20. Place main D/A PWA 24 on an extender board.

21. Trigger oscilloscope from pin 67 on the main D/A PWA 24.

22. Adjust HORIZ PHASE potentiometer on sync generator PWA 29 for coincidence of waveforms.

23. Adjust potentiometer R46 on the main D/A PWA 24 for the output video amplitude to be equal to the input video amplitude.

24. Adjust potentiometer R126 on video input PWA 17 for output video black level to be equal to input video black level.

25. Remove oscilloscope.

26. Connect channel 1 of vectorscope to VIDEO INPUT (rear connector panel); connect channel 2 to VIDEO OUTPUT NO. 1 (rear connector panel).

27. Adjust SUBC PHASE (subcarrier phase) on the front of clock generator PWA 20 and CHROMA PHASE (switch to variable) on the front panel of the velocity compensator 1 PWA to superimpose the two signals.

NOTE

**Potentiometer R12 is the chroma phase adjustment for units without the velocity compensator accessory and the unity chroma phase adjustment for units with the velocity compensator accessory. If the system is not equipped with a velocity compensator accessory, the chroma phase can be adjusted with resistor R12, through the access hole on the clock generator PWA 20 above the SUBC PHASE control.**

28. Adjust potentiometer R115 on the main D/A PWA to bring the chroma amplitude of the output video equal to that of the input video. The extender board affects this amplitude; R115 is correctly adjusted when output video and input video are equal with the main D/A PWA plugged into the machine (not on extender board). Correct adjustment of R115 may have to be estimated a few times.

**Velocity Compensator PWAs 26 and 27, Assembly Nos. 1374244 and 1374082**

Jumper lists for the velocity compensator PWAs are provided in Table 3-31 (PWA 26) and Table 3-32 (PWA 27). Align the Velocity Compensator PWAs 26 and 27, Assembly Nos. 1374244 and 1374082 as follows:

1. Place two-line delay PWA 23 on an extender board.

2. Install jumpers J1 and J2 on the two-line delay PWA 23 in the A - B position.

3. Adjust potentiometer R94 in accordance with the procedure given in the section entitled Two-Line Delay (NTSC), PWA 23, Assembly No. 1374058.

4. Using vectorscope, observe the AVR-2's video output.

5. Switch the UNITY/VARIABLE toggle switch on velocity compensator 1 PWA 26 to VARIable and observe the vector display while turning the CHROMA PHASE control through its range; there should be a ±30° shift of the vectors from the unity position.

6. Switch the UNITY/VARIABLE toggle switch on the velocity compensator 1 PWA 26 back to UNITY position.

7. Reinstall two-line delay PWA 23 in the system and place velocity compensator 1 PWA on the extender.

8. Remove Velocity Compensator 2 PWA 27 from the AVR-2 and connect one end of a five-inch wire (with a pin on both ends) to E9 (see Figure 3-85).

9. Reinsert the velocity compensator 2 PWA 27 into the AVR-2 and connect s scope probe to the unused pin on the five-inch wire lead. Set the scope to ac, maximum vertical gain, and sweep at 10 μs/cm, external horizontal drive (horizontal drive is available on PWA 26, pin 33/34).

10. Switch off velocity compensator 1 PWA 26. Adjust potentiometer R152 on velocity compensator 1 PWA 26 (Figure 3-86) to

Table 3-31. Jumper List, Velocity Compensator No. 1 PWA 26, Assembly No. 1374244

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B or<br>B - C | Position of jumper determined during factory test in order to minimize phase error. |

Table 3-32. Jumper List, Velocity Compensator No. 2 PWA 27, Assembly No. 1374082

| JUMPER | POSITION | REMARKS |
|---|---|---|
| J1 | A - B<br>B - C | NORMAL<br>Factory test (puts burst-hold error at OV to phase shifter). |
| J2 | A - B<br>Removed | NORMAL<br>Removed for factory test (opens phase loop in velocity error detector). |




Figure 3-85. Velocity Compensator No. 2 PWA 27, Assembly No. 1374082

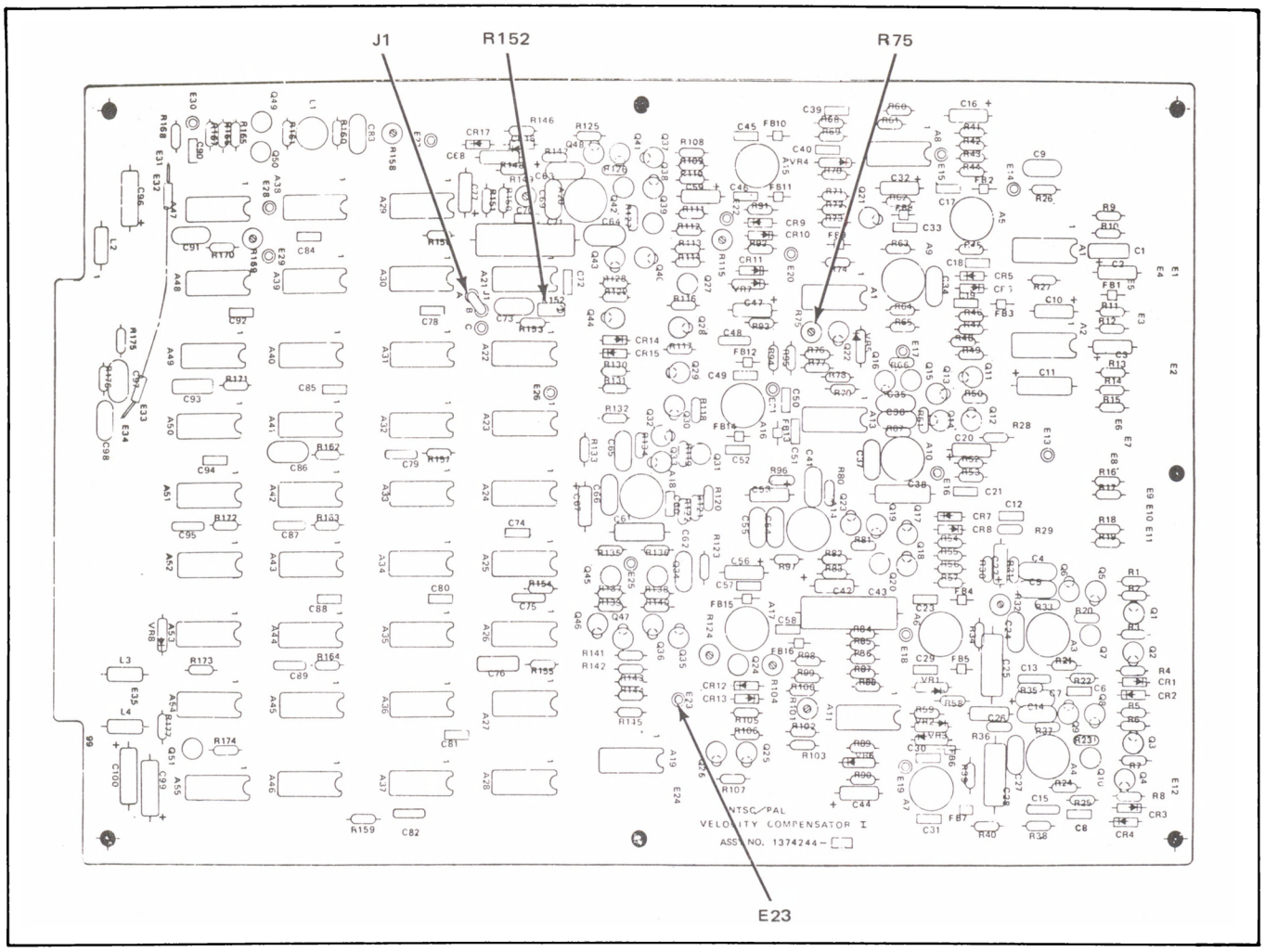



**Figure 3-86. Velocity Compensator No. 1 PWA 26, Assembly No. 1374244**

obtain the flattest display on the scope. See Figure 3-87.

11. Place jumper J1 on the velocity compensator 1 PWA 26 in the A - B or B - C position, whichever centers the adjustment range of R152 better. Note the final minimum signal level on the scope.

12. Remove velocity compensator 1 PWA 26 from the extender and reinsert PWA 26 into the AVR-2. If any change from the minimum level (as observed in previous step) is observed on the scope, remove PWA 26, make small adjustments to resistor R152, and reinsert PWA 26. Observe scope for minimum signal. Repeat this process as necessary to obtain the minimum signal.

13. On velocity compensator 2 PWA 27, move the test lead from tie lug E9 to tie lug E23.

14. Note the scope display. Remove velocity compensator 2 PWA 27 and make a small adjustment to resistor R236; reinsert the PWA and observe the scope (see Figure 3-88). Continue to make small adjustments until the minimum signal is attained through trial and error.

15. Remove the five-inch test lead from velocity compensator 2 PWA 27.

FIG. 3-87+88 ARE MISSING IN THIS BOOK.

# APPENDIX A
# AIR COMPRESSOR

An air compressor may be supplied with the AVR-2 at the customer's option. The air compressor supplied is manufactured by either Bell and Gossett or Gast. The Bell and Gossett is a 1/2 hp model number SYCGH12-1 specially adapted to Ampex's requirements.

The adapted version is similar to the standard model except that the piston has a longer stroke (0.560") and the pop safety valve is set for 75 psi.

Operation and maintenance information and a replacement parts list for this compressor is supplied by Bell and Gossett and is collated in this manual. See Page A-15.

Rings and valves may be expected to have to be replaced at 10,000 hour intervals of operation. The filter elements should be replaced at the same time the rings and valves are replaced.

The intake and exhaust valves are part nos. 87040 (intake) and 87041 (exhaust). Plug gasket 856760 and intake filter element C87081 should be replaced when the valves are changed. A special tool, part no. C82400, is available to facilitate value removal and replacement. Customarily the exhaust passage gasket part no. S56740 is replaced whenever the heads are removed to change rings and skirts or install a new piston rod and bearing assembly.

The piston rings (1 pair per cylinder) are part no. C87211 (1 pair). The backup springs (1 pair per cylinder) are part no. C87212 (1 pair). The piston skirt (1 per cylinder) is part no. C87044. The entire piston rod and bearing assembly including the rings, backup springs and skirt is available as part no. C87213. Installation requires pressing the connecting rods onto the motor shaft. Although this can be accomplished in the field it is best to have it done at an authorized service station. Authorized service stations are listed on page A-8. Field sales offices are listed on pages A-9 and A-10.

Ampex stocks some replacement parts for the Bell and Gosset, Model SYCGH12-1 compressor. The part name, Bell and Gossett part number and the Ampex part number for these parts is listed in Table A-1. Ampex also stocks a service kit, Ampex 052-220 (Bell and Gosset Number C87257) that contains the following items:

| | |
|---|---|
| C87040 | Intake Valve Assembly (2 ea) |
| C87041 | Exhaust Valve Assembly (2 ea) |
| C87044 | Teflon Tape Skirt (2 ea) |
| C87211 | Piston Ring, Teflon (2 ea) |
| S56740 | Exhaust Passage Gasket (2 ea) |
| S56760 | Plug Gasket (1 per plug) |

**Table A-1. Compressor Replacement Parts Available from Ampex**

| Part Name | Bell and Gossett Part Number | Ampex Part No. |
|---|---|---|
| Check Valve | C79282 | 803-578 |
| Muffler Cap Assembly | C807070 | 803-570 |
| Intake Filter Element | C87071 | 803-576 |
| Valve Wrench | C82400 | 803-580 |
| Intake Valve Assembly | C87040 | 803-577 |

Table A-1. Compressor Replacement Parts Available from Ampex (Continued)

| Part Name | Bell and Gossett Part Number | Ampex Part No. |
|---|---|---|
| Exhaust Valve Assembly | C87041 | 803-573 |
| Teflon Tape Skirt | C87044 | 803-581 |
| Muffler Cap | C87072 | 803-569 |
| Piston Ring – Teflon | C87211 | 803-583 |
| Piston Ring Spring | C87212 | 803-582 |
| Piston, Rod, and Bearing Assembly | C87213 | 803-585 |
| Coupling | J88962 | 803-579 |
| Exhaust Passage Gasket | S56740 | 803-584 |
| Plug Gasket | S56760 | 803-572 |
| Exhaust Valve Plug | S57200 | 803-571 |
| Intake Filter Felt | S57360 | 803-575 |
| Intake Filter Screen | S61000 | 803-574 |
| Safety Relief Valve (Set for 75 psi) | S75600 | 803-568 |

The air line filter used is a Norgren F04-200-AIT. The replacement element (with gaskets) is part no. 3652-01.

The relief valve is a Norgren V06-200-NNK. The replacement diaphragm is part no. 3440-03. Information on these items is contained on pages A-11 through A-12.

The Gast compressor model number is 4HCJ. The manufacturer's parts list and operating and maintenance instructions for this compressor is collated in this manual on pages A-16 through A-19. Ampex stocks some replacement parts for this compressor; Table A-2 provides a listing of the parts stocked.

Table A-2. Gast Compressor Parts Stocked by Ampex

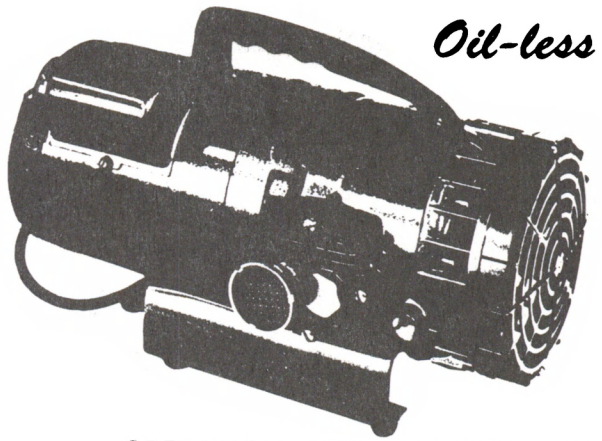
| AMPEX PART NUMBER | GAST PART NUMBER AND DESCRIPTION |
|---|---|
| 803-425 | K263 Service Kit to rebuild models 4HCC, 4HCJ and FHCD. Contains the following:<br>1. B344A Felt Filter (2 ea)<br>2. AF520 Head Gasket (2 ea)<br>3. AF545 Valve Outlet (2 ea)<br>4. AF544 Valve Inlet (2 ea)<br>5. AF521 Cylinder Gasket (2 ea)<br>6. AF541 Piston Ring (4 ea)<br>7. AF540 Piston Seal (4 ea)<br>8. AF595 Rider Ring (2 ea)<br>9. AF567A Manifold Sleeve (2 ea) |
| 370-015 | Felt Filter (B344A) |
| 052-199 | Jar (filter) (B306) |

REV. #1

# PARTS LIST
# 181102
# AIR COMPRESSORS AND VACUUM PUMPS

## ¼ THROUGH ¾ HP

*Oil-less*



## OPERATION AND MAINTENANCE

Only a few basic maintenance details are required to insure long life and trouble-free operation of any Oil-less Compressor. Always locate the compressor in a well-ventilated area where it will receive clean, cool, dry air. Surrounding and inlet air temperatures should not exceed 95 deg. F. Temperature should be even lower if operation is continuous. High temperatures will break down the lubrication in the compressor and motor bearings.

The intake filters must be kept clean for best performance. **Never operate a compressor without filters.** If the unit is used for paint spraying or other similar applications, locate the compressor far enough away to prevent rapid clogging of filter. To clean filter, first unscrew it from the cylinder head, then push out screens and felt pad and thoroughly wash these parts in thinner or solvent. Replace the felt pad after several cleanings.

For Vacuum Pumps, a good filter trap is available to prevent dirt, oil, etc. from being drawn into the cylinders. Filter trap, #SYC-1338, should be used for this purpose.

To produce cool. dry air upon discharge, a special after-cooler and moisture-collecting chamber is built into every compressor. Units equipped with check and unloader valves automatically eject moisture from the chamber each time the unit stops.

For units not equipped with check and unloader valves, the user can remove moisture by causing the compressor to build up back pressure to the point where the safety pop-off valve opens. This procedure should be repeated periodically. During periods of humid weather, it may be necessary every few hours of operation.

When using extension cords, do not use smaller than No. 16 gauge wire for a 25-foot extension, do not use smaller than No. 14 for a 50-foot extension, and do not use smaller than No. 12 wire for a 100-foot extension. Voltage at the compressor should not exceed ± 10% of voltage stamped on the nameplate. If the compressor starts slow or stalls, due to current deficiency, take the compression load off the unit during starting by relieving the back pressure.

DO NOT LUBRICATE ANY PART OF COMPRESSOR OR MOTOR. **These Bearings are grease packed and sealed for lifetime service.**


### GUARANTEE AND LIABILITY

ITT Pneumotive, A Unit of International Telephone and Telegraph Corporation, warrants that all PNEUMOTIVE products furnished by it for a period of one year after date of shipment from its factory to be free from defects in material and workmanship, subject only to the following:

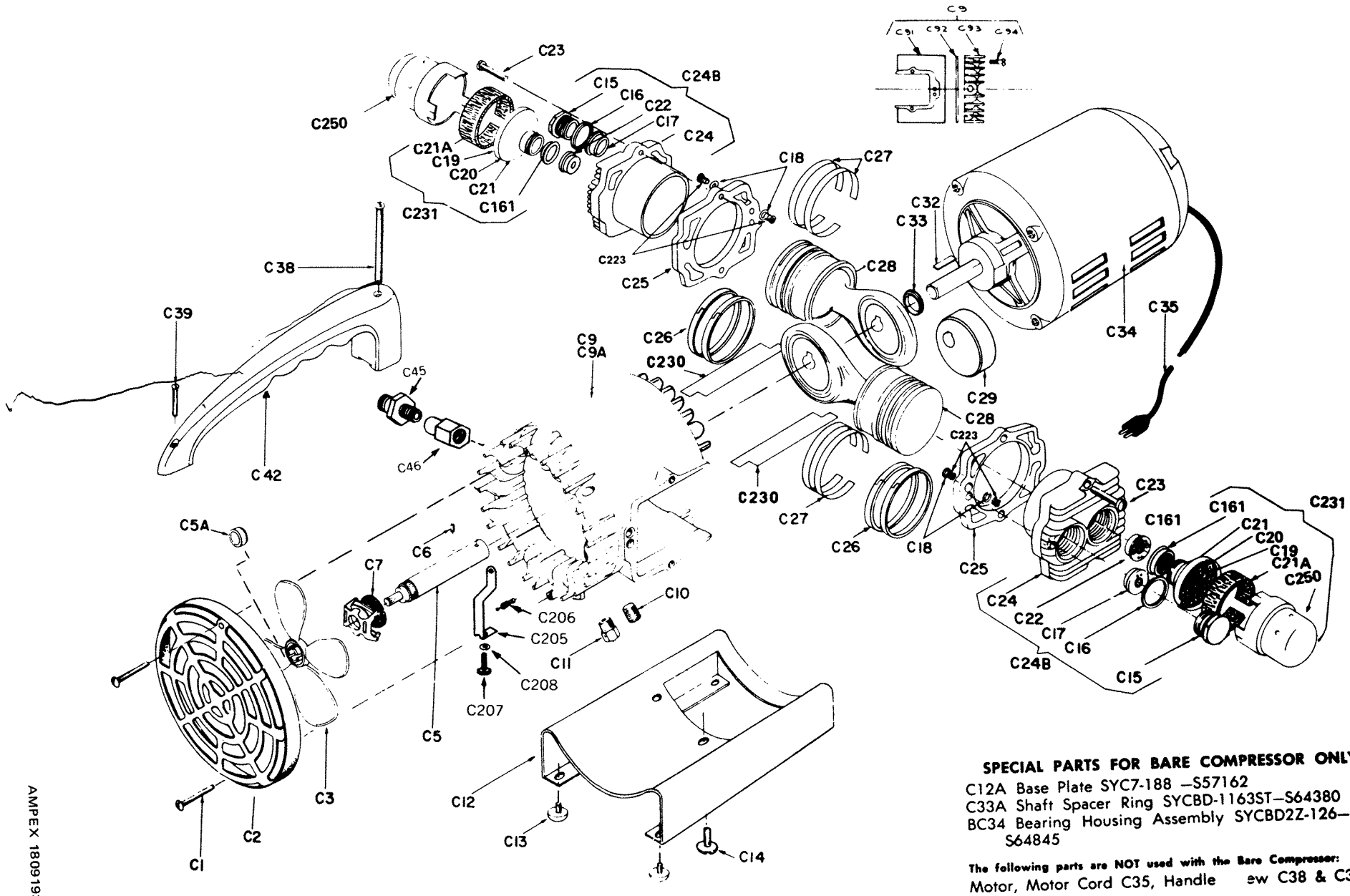
1. Manufacturer's liability under this warranty (and under any other warranty express or implied, statutory or otherwise) is limited to repair, or at Manufacturer's option, replacement of all parts which are shown to have been defective when shipped, and then only if Manufacturer is notified of such defects within such warranty period and such defective parts are promptly delivered to its factory at 4601 Central Avenue, Monroe, Louisiana 71201, transportation charges prepaid. Manufacturer's liability hereunder shall not be enforceable until such equipment has been full paid for. Except to the extent expressly assumed herein, Manufacturer's liability for incidental and consequential damage is hereby excluded to the full extent permitted by applicable law. Manufacturer's liability as stated herein cannot be altered or enlarged except by a writing signed by an officer of Manufacturer.
2. Replacement parts will be invoiced in the regular way with invoices subject to adjustment after the parts claimed defective are examined at our factory. ITT Pneumotive reserves the right to make such changes in details of design, construction or product arrangement as shall, in its judgment, constitute an improvement over former practice.

RETURNED GOODS: Written permission must be obtained before returning any material for any reason. Material returned for credit will be subject to factory inspection. In-warranty product, of current design will be subject to a rehandling charge less freight originally allowed. All material must be shipped with transportation charges prepaid.

Products which are obsolete or made to special order are not returnable.


PNEUMOTIVE ITT

# Compressor and Vacuum Pump
## Single Stage




**SPECIAL PARTS FOR BARE COMPRESSOR ONLY**

C12A Base Plate SYC7-188 —S57162
C33A Shaft Spacer Ring SYCBD-1163ST—S64380
BC34 Bearing Housing Assembly SYCBD2Z-126—S64845

**The following parts are NOT used with the Bare Compressor:**
Motor, Motor Cord C35, Handle ew C38 & C39

# REPLACEMENT PARTS FOR
# ¼ through ¾ H.P. COMPRESSORS
# SINGLE STAGE UNITS

ALWAYS GIVE THE MODEL NUMBER ON YOUR NAMEPLATE WHEN ORDERING PARTS

SEE P. 8 FOR MOTOR AND RELATED PARTS AND FOR PISTON, ROD & BEARING ASSEMBLY LISTINGS

(REF. NOS. C28, C28A, C33, C34, C35)

| REF. NO. | DESCRIPTION OF PARTS (1 per unit unless otherwise specified) | SINGLE STAGE 35 LB. COMPRESSORS | SINGLE STAGE 50 LB. COMPRESSORS | SINGLE STAGE 75 LB. COMPRESSORS | SINGLE STAGE 100 LB. COMPRESSORS |
|---|---|---|---|---|---|
| | | *¼ HP, Model No. SYC5-1 or 3527<br>¼ HP, Model No. SYC6-1 or 3138<br>⅓ HP, Model No. SYC7-1 or 3T48<br>½ HP, Model No. SYC8-1 or 3154<br>¾ HP, Model No. SYC9-1 or 3165 | ¼ HP, Model No. SYCGH5-1 or 3527GH<br>¼ HP, Model No. SYCGH6-1 or 3138GH<br>⅓ HP, Model No. SYCGH7-1 or 3T45GH<br>½ HP, Model No. SYCGH8-1 or 3154GH<br>¾ HP, Model No. SYCGH9-1 or 3165GH | *¼ HP, Model No. SYC10-1 or 7S19<br>⅓ HP, Model No. SYC11-1 or 7T28<br>½ HP, Model No. SYC12-1 or 7T38<br>¾ HP, Model No. SYC13-1 or 7T54 | ¼ HP, Model No. SYCGH10-1 or 7S19GH<br>⅓ HP, Model No. SYCGH11-1 or 7T28GH<br>½ HP, Model No. SYCGH12-1 or 7T38GH<br>¾ HP, Model No. SYCGH13-1 or 7T54GH |
| C 1 | Grill Screw (2 per unit) | SYC4-1187CD | S60580 | SYC4-1187CD | S60580 |
| C 2 | Grill | C2800P-0906P | C77802 | C2800P-0906P | C77802 |
| C 3 | Fan | C1200P-2303 | C80100 | C1200P-2303 | C80100 |
| C 5 | Fan Shaft | C40015-0604 | C78797 | C40015-0604 | C78797 |
| C 5A | Fan Hub Retainer (1 per unit) | C49008-0201P | C79042 | C49008-0201P | C79042 |
| C 6 | Fan Shaft Set Screw | SHP37-116ST | S24080 | SHP37-116ST | S24080 |
| **C 7 | Centrifugal Switch Assm. | SYC2Z-631 | None | SYC2Z-631 | None |
| C 9 | Body Assembly | SYC1Z-184 | S69500 | SYC1Z-184 | S69500 |
| C 9a | Body Assembly w/Check Valve & unloader | SYC2Z-183 | None | SYC2Z-183 | None |
| C10 | Body Plug ¼" NPT | None | None | None | None |
| C11 | Safety Relief Valve (See Note) | SYAR1-1 | S75580 | SYAR1-1 | S75600 |
| C12 | Base Plate | SYC6-188 | S57160 | SYC6-188 | S57160 |
| C13 | Base Plate Support Cushion (4 per unit) | SYC1-1189 | S60640 | SYC1-1189 | S60640 |
| C14 | Base Plate Fastener (2 per unit) | P-4267 | P05460 | P-4267 | P05460 |
| C15 | Exhaust Valve Plug (1 per cylinder) | SYC3-192 | S57200 | SYC3-192 | S57200 |
| C16 | Plug Gasket (1 per plug) | C5600A-0104P | S56760 | C5600A-0104P | S56760 |
| C17 | Exhaust Valve Assembly (1 per cylinder) | SYC1Z-178 | C87041 | SYC1Z-178 | C87041 |
| C18 | Exhaust Passage Gasket (2, 3 or 4 per unit) | SYC7-184 | S56740 | SYC7-184 | S56740 |
| C19 | Intake Filter Screen (2 per filter) | SYC1-1213 | S61000 | SYC1-1213 | S61000 |
| C20 | Intake Filter Felt (1 per filter) | SYC1-196 | S57360 | SYC1-196 | S57360 |
| C21 | Intake Filter Case (1 per cylinder) Single stage only | SYC3-195 | S57340 | SYC3-195 | S57340 |
| C21a | Intake Filter Element (see note) Single stage only | C87071 | C87071 | C87071 | C87071 |
| C22 | Intake Valve Assembly (1 per cylinder) | C79280 | C87040 | C79280 | C87040 |
| C23 | Cylinder Head Screw (3 per cylinder) 1st stage | J89059<br>SYC9 use J89060 | J89059<br>Except SYCGH9-1 which uses J89060 | J89059 | J89059 |

* 1 Cylinder Models
On Tankless 50# Units With Pressure Switch
Use S75580 Relief Valve
**C7—Use SYC3Z-631 For 50 Cycle

## (continued)—REPLACEMENT PARTS FOR ¼ through ¾ H.P. COMPRESSORS SINGLE STAGE UNITS

SEE P. 8 FOR MOTOR AND RELATED PARTS AND FOR PISTON, ROD & BEARING ASSEMBLY LISTINGS (REF. NOS. C28, C28A, C33, C34, C35)

| REF. NO. | DESCRIPTION OF PARTS (1 per unit unless otherwise specified) | SINGLE STAGE 25 LB. COMPRESSORS | SINGLE STAGE 50 LB. COMPRESSORS | SINGLE STAGE 75 LB. COMPRESSORS | SINGLE STAGE 100 LB. COMPRESSORS |
|---|---|---|---|---|---|
| | | *¼ HP, Model No. SYC5-1 or 3527<br>¼ HP, Model No. SYC6-1 or 3T38<br>⅓ HP, Model No. SYC7-1 or 3T45<br>⅓ HP, Model No. SYC8-1 or 3T54<br>¾ HP, Model No. SYC9-1 or 3T65 | ¼ HP, Model No. SYCGH5-1 or 3527GH<br>¼ HP, Model No. SYCGH6-1 or 3T38GH<br>⅓ HP, Model No. SYCGH7-1 or 3T45GH<br>½ HP, Model No. SYCGH8-1 or 3T54GH<br>¾ HP, Model No. SYCGH9-1 or 3T65GH | *¼ HP, Model No. SYC10-1 or 7S19<br>⅓ HP, Model No. SYC11-1 or 7T28<br>½ HP, Model No. SYC12-1 or 7T38<br>¾ HP, Model No. SYC13-1 or 7T54 | ¼ HP, Model No. SYCGH10-1 or 7S19GH<br>⅓ HP, Model No. SYCGH11-1 or 7T28GH<br>½ HP, Model No. SYCGH12-1 or 7T38GH<br>¾ HP, Model No. SYCGH13-1 or 7T54GH |
| C 24 | Cylinder Head & Sleeve Assem. (1 per piston) | SYC3Z-194 | C87059 | SYC3Z-194 | C87059 |
| C 24a | Cylinder Head & Sleeve Assem. | None | None | None | None |
| C 24b | Cylinder Head Complete (see note) (1 per cylinder) | SYC3Z-1184 | C87060 | SYC3Z-1184 | C87060 |
| C 24c | Cylinder Head Complete (see note) | None | None | None | None |
| C 25 | Cylinder Head Spacer | None used except on ¾ HP which uses SYC1-123S(2) S61100 | S61100 ¾ HP only | None | None |
| C 25a | Cylinder Head Spacer | None | None | None | None |
| C 26 | Piston Ring—Carbon (1 per<br>Piston Ring—Teflon (set of 2) | SYC-1143<br>C87210 Std. | None<br>C87211 | SYC-1143<br>C87210 | None<br>C87211 |
| C 27 | Piston Ring Spring | C13008-1401P | C87212(2) | C13008-1401P | C87212(2) |
| C 29 | Piston Counter Weight | None used except on ¼ HP H Cyl. which uses SYC1-1193 | None used except on ¼ single only S60780 | None used except on ⅓ HP, which uses SYC2-1193 | None used except on ¼ HP, which uses C87109 |
| C 32 | Motor Shaft Key | SYC-1138 | S59200 | SYC-1138 | S59200 |
| C 36 | Bushing | None | None | None | None |
| C 37 | Elbow Fitting | None | None | None | None |
| C 38 | Handle Screw | J16008-0116 | J91910 | J16008-0116 | J91910 |
| C 39 | Handle Screw (Small) | SYC2-1187 | S60520 | SYC2-1187 | S60520 |
| C 42 | Handle | C5000P-0933P | C79080 | C5000P-0933P | C79080 |
| C 43 | Manifold | None | None | None | None |
| C 44 | Elbow | None | None | None | None |
| C 45 | Check Valve | C79282 | C79282 | C79282 | C79282 |
| C 46 | Coupling | J88962 | J88962 | J88962 | J88962 |
| C 47 | Tee | ***C87010 | ***C87010 | ***C87010 | ***C87010 |
| C 48 | Adapter | None | None | None | None |
| C205 | Unloader Arm | C79085 | None | C79085 | None |
| C206 | Unloader Valve | C79240 | None | C79240 | None |
| C207 | Unloader Arm Screw | M37800 | None | M37800 | None |
| C208 | Unloader Arm Washer | S76120 | None | S76120 | None |
| C 91 | Crankcase | SYC1-183 | S56980 | SYC1-183 | S56980 |
| C 92 | Crankcase Gasket (1) | SYC-156 | S56820 | SYC-156 | S56820 |
| C 93 | Crankcase Plate (1) | SYC1-184 | S57080 | CQ300A-0315P | S57080 |
| C 93a | Cover Plate if Unloader used | C87229 | None | C87229 | None |
| C 94 | Crankcase Screw (16) | SYC1-1187 CD | S60500 | SYC1-1187CD | S60500 |
| C 95 | Adaptor | SYC-1225 | None | SYC-1225 | None |
| C161 | Filter Spacer | C87099 | C87099 | C87099 | C87099 |
| C223 | Gasket Retainer | C75640 | C75640 | C75640 | C75640 |
| C230 | Teflon Tape Skirt | None | C87044 | C87044 | C87044 |
| C231 | Muffler Cap Assembly | C87070** | C87070** | C87070** | C87070** |
| C250 | Muffler Cap Only | C87072 | C87072 | C87072 | C87072 |

*1 Cylinder Models

**Includes Muffler Cap.

***Used on tankless units only
C24 D-S57320 dummy head 1 each on single cylinder units (not illustrated)

## PISTON, ROD & BEARING ASSEMBLY
## MOTOR AND RELATED PARTS

| REF. NO. | MODEL | C28 & 28A DESCRIPTION OF PARTS | C34 | MODEL | C28 & 28A DESCRIPTION OF PARTS | C34 |
|---|---|---|---|---|---|---|
| STAGE | 35 LB. COMPRESSOR | PISTON, ROD & BEARING ASSEM. | C34 MOTOR | 35 LB. COMPRESSOR | PISTON, ROD & BEARING ASSEM. | C34 MOTOR |
| SINGLE STAGE COMPRESSOR | ¼ HP 1 CYL SYC5-1 or 3827 | SYC7Z-1180 | M80250 | SYCGH5-1 | C87217** | M80250 |
| | ⅓ HP SYC6-1 or 3T38 | SYC9Z-1180 | M80250 | SYCGH6-1 | C87221** | M80250 |
| | ½ HP SYC7-1 or 3T45 | SYC19Z-1180 | M80265 | SYCGH7-1 | C87213** | M80265 |
| | ½ HP SYC8-1 or 3T54 | SYC7Z-1180 | M80275 | SYCGH8-1 | *C87227** | M80275 |
| | ¾ HP SYC9-1 or 3T65 | SYC8Z-1180 | M80780 | SYCGH9-1 | C87215** | M80780 |
| | 75 LB. COMPRESSOR | | | 100 LB. COMPRESSOR | | |
| SINGLE STAGE COMPRESSOR | ¼ HP 1 CYL SYC10-1 or 7S19 | SYC9Z-1180 | M80250 | SYCGH10-1 | C87216** | M80250 |
| | ⅓ HP SYC11-1 or 7T28 | SYC14Z-1180 | M80265 | SYCGH11-1 | C87219** | M80265 |
| | ½ HP SYC12-1 or 7T38 | SYC9Z-1180 | M80275 | SYCGH12-1 | C87213** | M80275 |
| | ¾ HP SYC13-1 or 7T54 | SYC7Z-1180 | M80780 | SYCGH13-1 | C87217** | M80780 |
| | 175 LB. COMPRESSOR | | | GH 175 LB. COMPRESSOR | | |
| TWO STAGE COMPRESSOR | ½ HP SYC15-1 or 17T19 | " " | M80265 | SYCGH15-1 | " " | M80265 |
| | ½ HP SYC16-1 or 17T27 | " " | M80275 | SYCGH16-1 | " " | M80275 |
| | ¾ HP SYC17-1 or 17T32 | " " | M80780 | SYCGH17-1 | " " | M80780 |
| | HIGH VOLUME VACUUM | | | HIGH VOLUME GH VAC | | |
| VACUUM | ¼ HP SYC18-1 or 2T45 | SYC19Z-1180 | M80250 | SYCGH18-1 | C87213** | M80250 |
| | ⅓ HP SYC19-1 or 2T54 | SYC7Z-1180 | M80265 | SYCGH19-1 | C87217** | M80265 |
| | ½ HP SYC20-1 or 2T65 | SYC8Z-1180 | M80275 | SYCGH20-1 | C87218** | M80275 |
| | ¼ HP 1 CYL SYC20-1 or 2S27 | SYC7Z-1180 | M80250 | SYCGH21-1 | C87217** | M80250 |

C33 Motor Spacer Ring S60180 Fits All Models

C35 Cord & Plug C77110 Fits All Models—115-60-1ϕ Except ¾ HP Use S63540

*Piston & Rod Assembly For SYCGH8-1 Only

**All First Stage Piston Assemblies Include Teflon Skirt-Rings and Backup Spring

## PRESSURE OR VACUUM SWITCH REPLACEMENT PARTS

| REF. NO. | DESCRIPTION OF PARTS | PART NUMBER | 50 # SINGLE STAGE | 100 # SINGLE STAGE | HIGH VOLUME VACUUM | TWO STAGE 175 # |
|---|---|---|---|---|---|---|
| C50 | Pressure Switch (on 175# units) | SYC13-1320 | None | None | S62580 | S61860 |
| C50A | Pressure Switch (on 35 & 75# units) | SYC11-1320 | S61820 | S61820 | None | None |
| C50B | Vacuum Switch | SYC1459 | None | None | S62580 | None |
| C51 | Cord Connector | MOT277-6366 | None | None | None | None |
| C52 | Conduit Connector | SYC1-364 | S58040 | S58040 | S58040 | S58040 |
| C52A | Conduit Connector | SYC-364 | S58020 | S58020 | S58020 | S58020 |
| C53 | Stakon Connector | SYC-1371 | S62630 | S62630 | S62630 | S62630 |
| C54 | Wire Loom | SYCO1-1411 | C87222 | C87222 | C87222 | C87222 |
| C55 | Conduit (with ¼ HP unit only) | SYC4-1326 | See note #1 | See note #1 | See note #1 | See note #1 |
| C55A | Conduit (with ⅓ HP unit only) | SYC5-1326 | See note #2 | See note #2 | See note #2 | See note #2 |
| C55B | Conduit (with ½ HP units only) | C0700S-0416 | See note #3 | See note #3 | See note #3 | See note #3 |
| C55C | Conduit (with ¾ HP unit only) | C0701S-0416 | See note #4 | See note #4 | See note #4 | See note #4 |
| C58 | Stakon Lug | SYCT2-379 | C77630 | C77630 | C77630 | C77630 |

Note # 1 Part C87104—½-⅓-¼ 3ϕ & ¼ 115-60-1ϕ

Note #2 Part C87105--¾ 3ϕ-¼-⅓ 50HZ—⅓-60HZ

Note #3 Part C 87106—¾-50HZ 1ϕ

Note #4 Part C 87107 ½-¾ 60 HZ 1ϕ & ½-50HZ 1ϕ

See illustration of compressor pressure switch replacement parts page 7

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Garden Grove (Los Angeles), Calif. 92641
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A/C 713-666-2801
* (1, 2)

Southwestern Controls
1804 N. Industrial Boulevard
Dallas, TX 75207
A/C 214-742-6266
(1, 2)

Boyd Engineering Company
1801 Magoffin
El Paso, TX 79901
A/C 915-533-7575
(2)

**UTAH**
Curzon Fluid Power Co.
1590 South 300 West
Salt Lake City, UT 84115
A/C 801-532-1470
(1, 2)

**WASHINGTON**
Rogers Machinery Co., Inc.
7800 Fifth Ave. South
Seattle, WA 98108
A/C 206-763-2530
(1, 2)

Rogers Machinery Co., Inc.
2404 Harrison Avenue
Centralia, WA 98531
A/C 206-736-9356
(1, 2)

**WEST VIRGINIA**
K. C. Mosier Co.
521 "C" Street
South Charleston, WV 25300
A/C 304-744-5356
(1, 2)

Scott Fluid Power Prod.
2825 Jacobs Street
Wheeling, WV 26003
A/C 304-232-6006
* (2)

**AREA MANAGERS**

**CHICAGO**
Mr. Jim Fitzpatrick
3794 Windermore
St. Joseph, MI 49085
A/C 616-429-5782

**NORTH OHIO AND MICHIGAN**
Mr. Carl D. Whisler
40 Edgewood Drive
Grafton, OH 44044
A/C 216-458-6500

**NEW YORK METROPOLITAN**
Mr William W. Rafos
706 Ramapo Road
Teaneck, NJ 07666
A/C 201-692-0544

**NEW YORK (UPSTATE)**
Mr. Robert P. Conniff
4306 Ironwood Circle
Liverpool, NY 13088
A/C 315-652-6641

**WASHINGTON AND OREGON**
Mr. F. H. Stevens
P. O. Box 88861
Tukwila Station
Seattle, WA 98188
A/C 206-246-0150

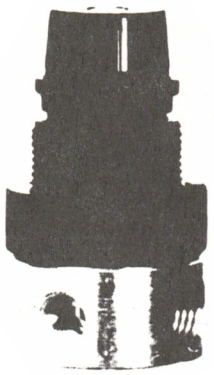
**NORTH AND SOUTH CAROLINA GEORGIA AND FLORIDA**
Mr. Marc Stohl
4029 Chase Court
Decatur, GA 30034
A/C 404-289-3656

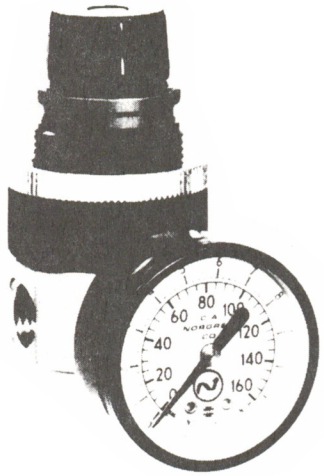
NC-702
June, 1973
Supersedes July, 1970

TYPE V06

# MINIATURE RELIEF VALVE

## 1/8"AND 1/4" PIPE SIZES COMPRESSED AIR SERVICE (ALUMINUM) WATER, NONCORROSIVE LIQUIDS (BRASS)





### APPLICATION

In compressed air or water applications to retard excessive pressure build-up and help prevent damage to system components.

### SPECIFICATIONS

PIPE SIZES: 1/8", 1/4"
GAUGE PORT: 1/8"
RELIEF RANGES*: 2-100 PSIG (STANDARD
1-10 PSIG (OPTIONAL)
1-50 PSIG (OPTIONAL)

MAXIMUM RECOMMENDED TEMPERATURE RANGE:
0°F. TO 150°F. (PLASTIC BONNET)
0°F. TO 200°F. (BRASS BONNET)

*Can be adjusted to 0 psig.

### FEATURES

Helps inhibit an over pressure condition which could cause damage to system components.

Miniature in size – only 2-5/8" high.

Standard unit for compressed air service has aluminum body and acetal resin bonnet. For applications with water unit can be furnished with brass body and seat.

### CAUTION

FOR USE WITH MEDIA OTHER THAN AIR OR NON-CORROSIVE LIQUIDS, OR FOR LIFE-SUPPORT SYSTEMS, CONSULT YOUR DISTRIBUTOR FOR FACTORY APPROVAL. DO NOT USE WHERE PRESSURES OR TEMPERATURES MAY EXCEED SPECIFIED MAXIMUM RECOMMENDED OPERATING CONDITIONS.

### ORDER TABLE

Standard models normally available from distributor stock.

FOR COMPRESSED AIR SERVICE (Aluminum body)

| | STANDARD | OPTIONAL MODELS | |
|---|---|---|---|
| PIPE SIZE | 2-100 PSIG | 1-50 PSIG | 1-10 PSIG |
| ⅛" | V06-100-NNK-AU | V06-100-NNE-AU | V06-100-NNA-AU |
| ¼" | V06-200-NNK-AU | V06-200-NNE-AU | V06-200-NNA-AU |

FOR WATER AND NON-CORROSIVE LIQUIDS(Brass body)

| | STANDARD | OPTIONAL MODELS | |
|---|---|---|---|
| PIPE SIZE | 2-100 PSIG | 1-50 PSIG | 1-10 PSIG |
| ⅛" | V06-121-NNK-AU | V06-121-NNE-AU | V06-121-NNA-AU |
| ¼" | V06-221-NNK-AU | V06-221-NNE-AU | V06-221-NNA-AU |

Standard relief valves (not pre-set*) normally available from distributor stock

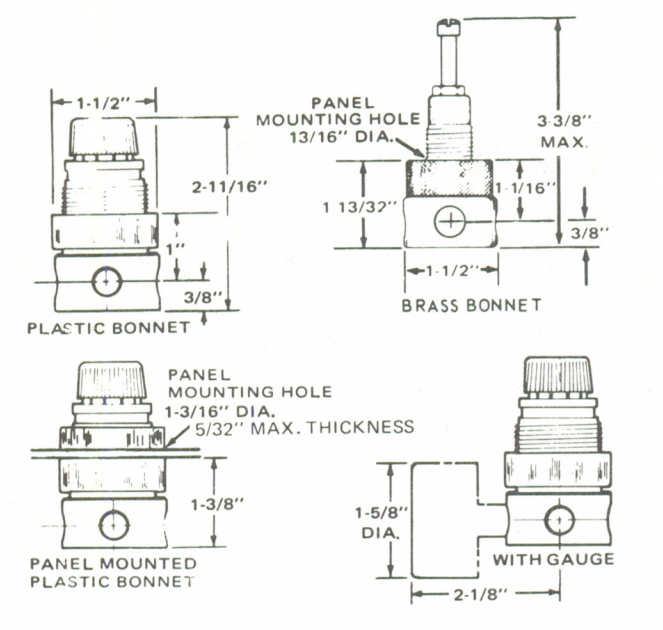
(*For pre-set relief valves, substitute "P" in the 7th digit. When ordering specify the setting.)

To order both brass body and brass bonnet, insert "22" in the 5th and 6th positions of model number.

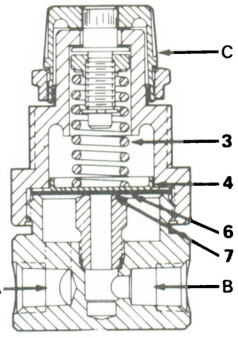
| ACCESSORIES | | |
|---|---|---|
| ACCESSORY | ORDERED WITH | SEPARATELY |
| Panel Mounting Nut | 18-025-002 | 2962-89 |
| Wall Mounting and Panel Nut | 18-025-003 | 18-025-010 |
| Gauge. ⅛" center-back connection, 1½" black metal case, plastic crystal. 0- 60 psig | | 18-013-211 |
| 0-160 psig | | 18-013-212 |

NORGREN
LITTLETON, COLORADO ©

## MOUNTING DIMENSIONS



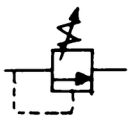

## OPERATION




Primary air enters inlet port (A) and flows through the valve body to exert pressure on the bottom of the diaphragm (6). If pressure exceeds the force exerted by the regulating spring (3), the diaphragm moves upward with the spring rest (4), allowing air pressure to escape through the valve to the secondary or outlet port (B). The desired relief pressure is set by the adjusting knob (C).

When the excess pressure has been relieved and the regulating spring force becomes equal to or greater than the system pressure, the diaphragm comes in contact with the valve seat (7), preventing further escape. The diaphragm acts against the seat eliminating the need for a separate valve.

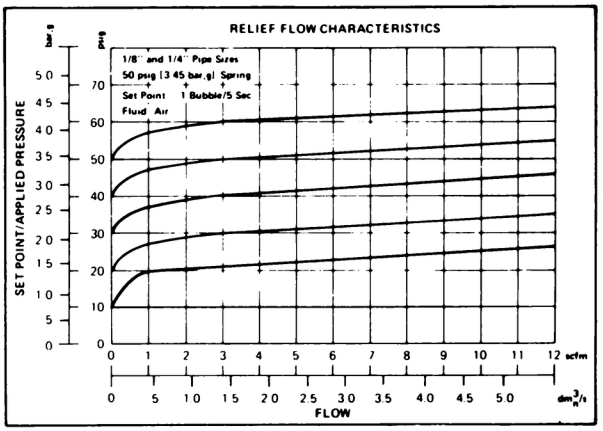
## GRAPHIC SYMBOL

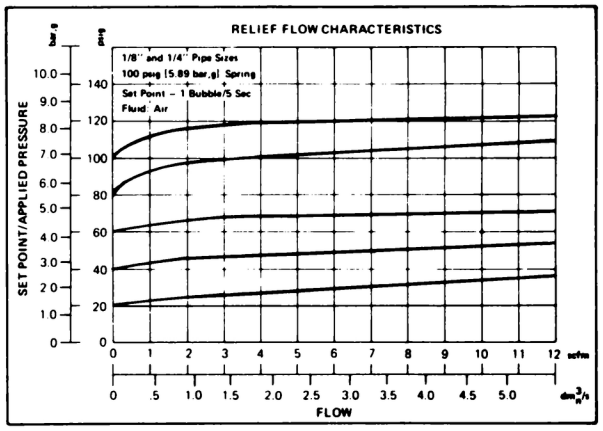


## PARTS

| | |
|---|---|
| Bonnet assembly (plastic) | 2950-54 |
| Bonnet assembly (brass) | 596-70 |
| Spring – 50 psig | 613-03 |
| – 100 psig | 2960-04 |
| – 10 psig | 2069-02 |
| Spring rest | 3441-01 |
| Slip ring | 615-01 |
| Diaphragm | 3440-03 |
| Valve seat, aluminum | 3439-01 |
| brass | 3439-02 |

## PERFORMANCE CHARACTERISTICS




FOR FURTHER INFORMATION REFER TO NIP-702

**CHECK WITH THE FACTORY FOR APPLICATIONS OTHER THAN COMPRESSED AIR SERVICE.**


**C.A. NORGREN CO.**
*LITTLETON, COLORADO* *80120 / 303-794-2611*


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Printed in U.S.A.

NC-702/6-73

NIP-110
August, 1972
Supersedes July, 1970

**Type F04**

# MINIATURE FILTER

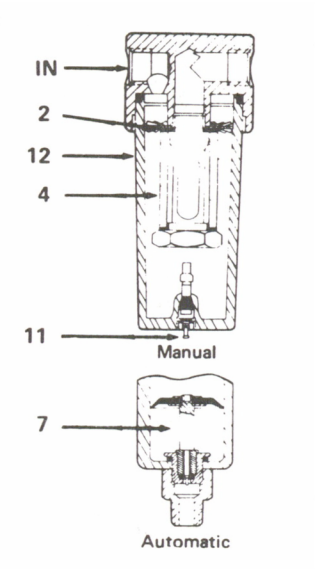
## 1/8"& 1/4" PIPE SIZES • MANUAL AND AUTOMATIC DRAIN FOR COMPRESSED AIR SERVICE

### OPERATION

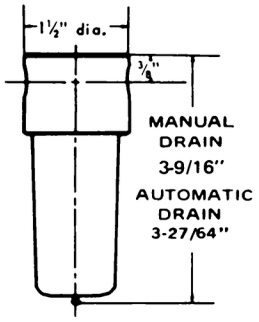
Air entering the filter is directed through the louvers (2) imparting a centrifugal pattern to the air flow. Solid particles and liquids are forced to the outside of the bowl (12) by the centrifugal flow and settle to the bottom of the bowl.

The air then passes through the sintered bronze element (4) where remaining solid particles are removed (depending on the micron rating of the element).

Water accumulating in the bottom of the bowl may be manually drained by operating the manual drain valve (11), or it may be expelled automatically as downstream flow is cycled in automatic drain models (7).



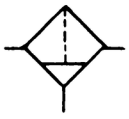

### DIMENSIONS



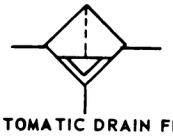

### INSTALLATION

Install the filter upstream of the regulator and lubricator in the compressed air line, as near as possible to the machine or device it is to serve. The arrow on the body indicates the direction of air flow through the filter.

### GRAPHIC SYMBOLS



MANUAL DRAIN FILTER



AUTOMATIC DRAIN FILTER

### SPECIFICATIONS

PIPE SIZES: 1/8", 1/4"

FILTER ELEMENT: 5 MICRON
100 MICRON

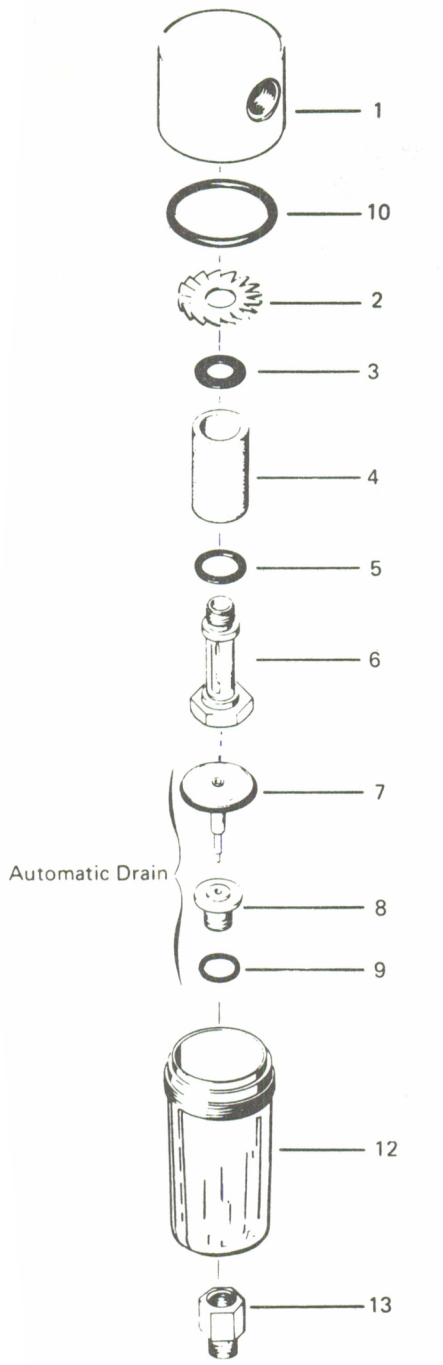
BOWL: 1/2-OZ. SAFETY-GREEN TRANSPARENT
1/2-OZ. METAL

RECOMMENDED OPERATING TEMPERATURE RANGE:
32° F. TO 175° F. AMBIENT

MAXIMUM RECOMMENDED OPERATING CONDITIONS:
250 PSIG AT 120° F. AMBIENT (METAL BOWL)
200 PSIG AT 120° F. AMBIENT (POLYCARBONATE BOWL)
100 PSIG AT 175° F. AMBIENT (POLYCARBONATE BOWL)

MANUAL OR AUTOMATIC DRAIN

NORGREN
LITTLETON, COLORADO ©




## *PARTS*

AUTOMATIC DRAIN CONVERSION KIT
contains items 7, 8, 9, 12, 13 . . . . . 3653-01
REPAIR KIT FOR AUTO DRAIN MECHANISM
contains items 7, 8, 9 . . . . . 3654-01
4. 5-Micron element contains items 3, 4, 5 . . . . . 3652-01
4. 100-Micron element contains items 3, 4, 5 . . . . . 3652-03
12. Bowl assembly, manual drain (Polycarbonate) . . . . . 3635-51
12. Bowl assembly, automatic drain (Polycarbonate) . . . . . 3635-52

**FOR ORDERING INFORMATION CONCERNING COMPLETE UNIT REFER TO NC-110**

## *MAINTENANCE*

MANUAL DRAIN MODELS: To service the filter, shut off the air pressure. Unscrew bowl assembly (12) and remove "O" ring (10). Unscrew stud (6) and from the stud remove filter element (4), louver (2) and gaskets (3 & 5). The filter element should be cleaned periodically with a petroleum solvent and blown out with compressed air.

AUTOMATIC DRAIN MODELS: To service the filter, shut off the air pressure. Unscrew bowl assembly (12) and remove "O" ring. Unscrew stud (6) and from the stud remove filter element (4), louver (2) and gaskets (3 & 5).

To disassemble the bowl assembly, remove valve assembly (7) by turning the bowl upside down and shaking. Unscrew nut (13) and remove insert assembly (8) and "O" ring (9).

During assembly procedure, make sure the valve assembly lip (7) is in a turned-down position. To turn the lip down use a blunt tool such as a pencil or a piece of cardboard. CAUTION: Do not scratch the bowl surface while turning lip down.

CAUTION: INSPECT AND CLEAN EACH PART CAREFULLY USING ONLY CLEAN, WARM WATER OR KEROSENE. BLOW AIR THROUGH ELEMENT INSIDE TO OUTSIDE TO DISLODGE ANY SURFACE CONTAMINENTS.

Repair kits or Replacement Parts should be ordered from the Norgren Distributor in your area, using the illustrated parts breakdown as a guide.

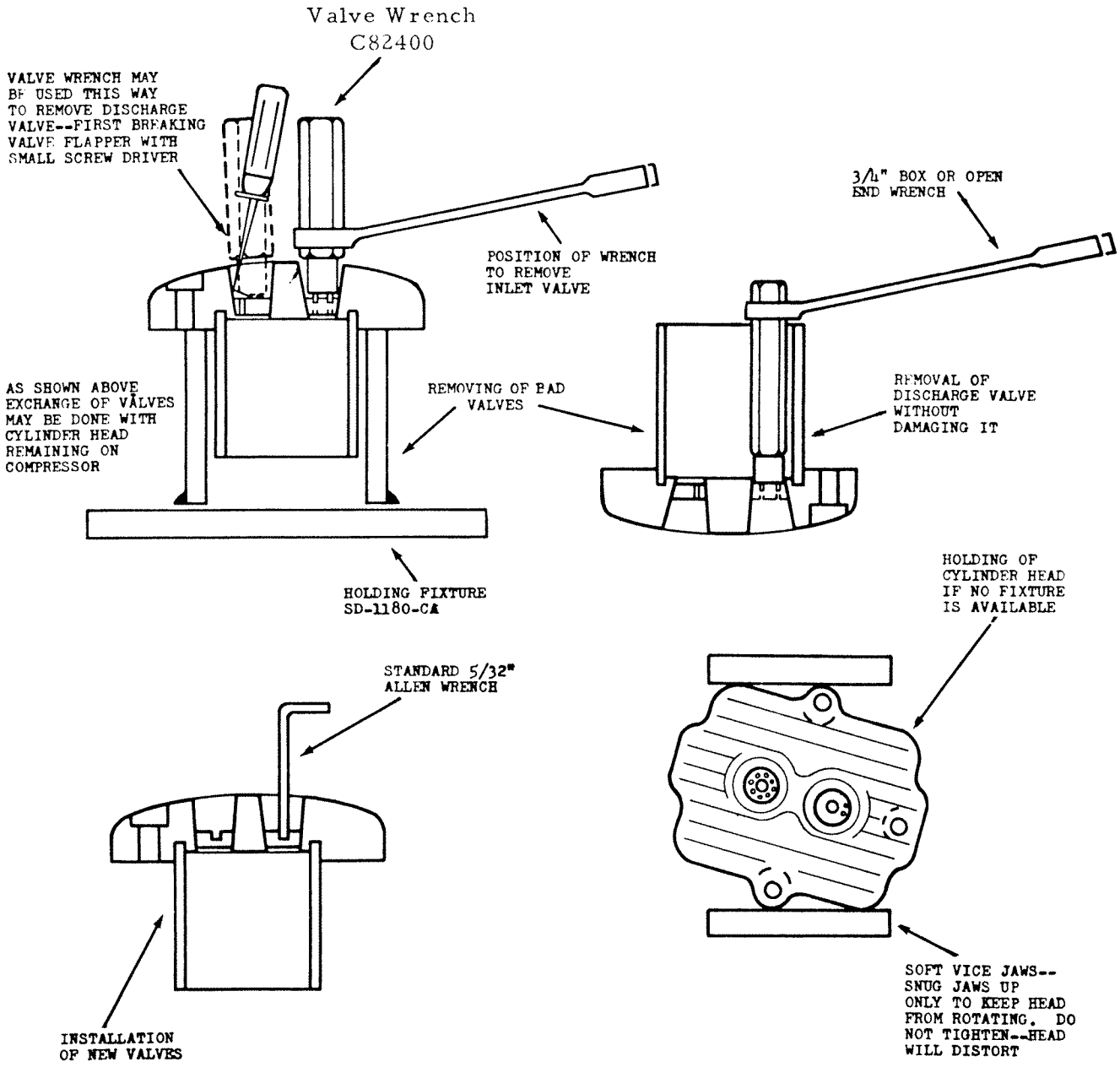
## *CAUTION*

THIS FILTER SHOULD NOT BE USED IN APPLICATIONS WHICH MAY EXCEED MAXIMUM RECOMMENDED OPERATING CONDITIONS. DURING MAINTENANCE PERIODS CLEAN AND INSPECT EACH PART CAREFULLY USING ONLY CLEAN, WARM WATER OR KEROSENE. DO NOT USE SOLVENTS AS THE POLYCARBONATE BOWL MAY BE DAMAGED.

NIP-110/8-72

**C. A. NORGREN CO.**
*LITTLETON, COLORADO 80120 / 303-794-2611*
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# *OIL-LESS* AIR COMPRESSOR
# VALVE Servicing Instructions




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PRINTED IN U.S.A. 11-66

BELL & GOSSETT MORTON GROVE, ILL. 60053
Fluid Handling Division, International Telephone and Telegraph Corporation ITT

GAST MANUFACTURING CORPORATION
P. O. BOX 97, BENTON HARBOR, MICHIGAN 49022
PHONE 616-926-6171

# PARTS LIST AND OPERATING AND MAINTENANCE INSTRUCTIONS FOR MODELS

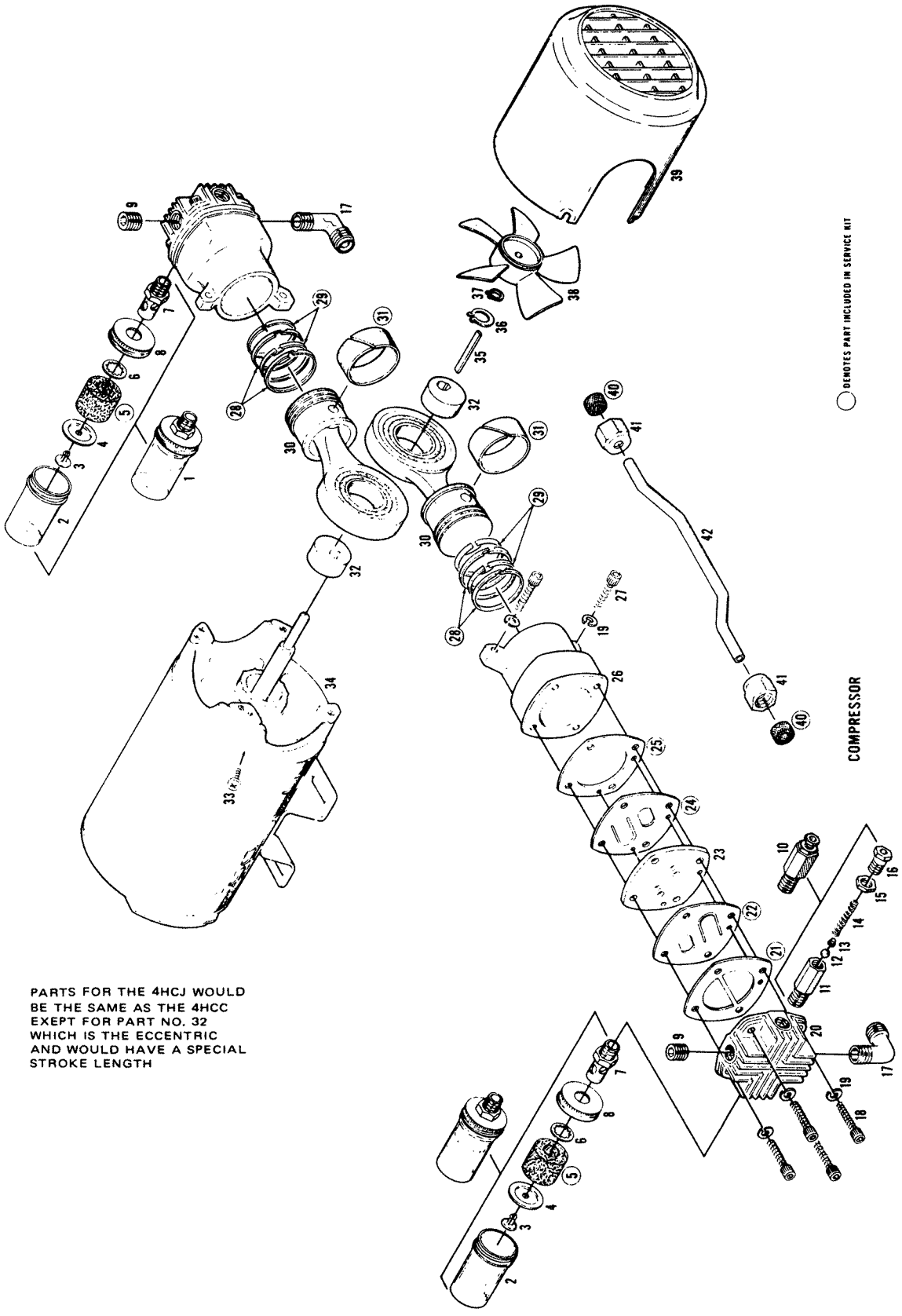
## 50 PSI
## 4LCB
## 5LCA

## 100 PSI
## 4HCJ
## 5HCD

# OIL-LESS RECIPROCATING AIR COMPRESSORS



AMPEX 1809193-01




PARTS FOR THE 4HCJ WOULD BE THE SAME AS THE 4HCC EXEPT FOR PART NO. 32 WHICH IS THE ECCENTRIC AND WOULD HAVE A SPECIAL STROKE LENGTH

| REF. NO. | PART NO. | DESCRIPTION | QUANTITY REQUIRED | | | |
|---|---|---|---|---|---|---|
| | | | 4LCB | 4HCC | 5LCA | 5HCD |
| 1 | B300A | INLET FILTER | 2 | 2 | 2 | 2 |
| 2 | B306 | JAR | 2 | 2 | 2 | 2 |
| 3 | B378 | RIVET STUD | 2 | 2 | 2 | 2 |
| 4 | AA730 | END CAP | 2 | 2 | 2 | 2 |
| 5 | B344A | FELT | 2 | 2 | 2 | 2 |
| 6 | B307 | RETAINING RING | 2 | 2 | 2 | 2 |
| 7 | B303 | BODY | 2 | 2 | 2 | 2 |
| 8 | B305 | CAP | 2 | 2 | 2 | 2 |
| 9 | BA503 | PIPE PLUG | 2 | 2 | 2 | 2 |
| 10 | AF570A | SAFETY VALVE | 1 | 1 | 1 | 1 |
| 11 | AF608 | BODY | 1 | 1 | 1 | 1 |
| 12 | AF572 | BALL | 1 | 1 | 1 | 1 |
| 13 | AF579 | SPRING BUTTON | 1 | 1 | 1 | 1 |
| 14 | AF609 | SPRING | 1 | 1 | 1 | 1 |
| 15 | AA96 | LOCK NUT | 1 | 1 | 1 | 1 |
| 16 | AA314 | ADJUSTMENT SCREW | 1 | 1 | 1 | 1 |
| 17 | AF566 | MANIFOLD ELBOW | 2 | 2 | 2 | 2 |
| 18 | BB619 | HEAD SCREW | 8 | 8 | 8 | 8 |
| 19 | BC115 | LOCKWASHER | 12 | 12 | 12 | 12 |
| 20 | AF507 | CYLINDER HEAD | 2 | 2 | 2 | 2 |
| 21 | AF520 | HEAD GASKET | 2 | 2 | 2 | 2 |
| 22 | AF545 | VALVE, OUTLET | 2 | 2 | 2 | 2 |
| 23 | AF543 | VALVE PLATE | 2 | 2 | 2 | 2 |
| 24 | AF544 | VALVE, INLET | 2 | 2 | 2 | 2 |
| 25 | AF521 | CYLINDER GASKET | 2 | 2 | 2 | 2 |
| 26 | AF509 | CYLINDER | 2 | 2 | 2 | 2 |
| 27 | BB619 | CYLINDER SCREW | 4 | 4 | 4 | 4 |
| 28 | AF541 | PISTON RING | 4 | 4 | 4 | 4 |
| 29 | AF540 | PISTON SEAL | 4 | 4 | 4 | 4 |
| 30 | AF561 | PISTON ROD ASSEMBLY | 2 | 2 | 2 | 2 |
| 31 | AF542 | RIDER RING | 2 | | 2 | |
| 31 | AF595 | RIDER RING | | 2 | | 2 |
| 32 | AF515A | ECCENTRIC | | | 2 | |
| 32 | AF515B | ECCENTRIC | 2 | | | |
| 32 | AF515C | ECCENTRIC | | 2 | | |
| 32 | AF515D | ECCENTRIC | | | | 2 |
| 33 | BB411 | SCREW | 4 | 4 | 4 | 4 |
| 34 | AF500A | BRACKET | | | 1 | |
| 34 | AF500B | BRACKET | 1 | | | |
| 34 | AF500C | BRACKET | | 1 | | |
| 34 | AF500D | BRACKET | | | | 1 |
| 35 | AB136D | SQUARE KEY | 1 | 1 | 1 | 1 |
| 37 | AC446 | RETAINING RING | 1 | 1 | 1 | 1 |
| 38 | AF547 | FAN | 1 | 1 | 1 | 1 |
| 39 | AF549 | SHROUD | 1 | 1 | 1 | 1 |
| 40 | AF567 | MANIFOLD SLEEVE | 2 | | 2 | |
| 40 | AF567A | MANIFOLD SLEEVE | | 2 | | 2 |
| 41 | AF568 | MANIFOLD NUT | 2 | 2 | 2 | 2 |
| 42 | AF550A | MANIFOLD | | | 1 | |
| 42 | AF550B | MANIFOLD | 1 | | | 1 |
| 42 | AF550C | MANIFOLD | | 1 | | |

To rebuild models 4LCB & 5LCA, order service kit number K262

To rebuild models 4HCC & 5HCD, order service kit number K263

When corresponding or ordering spare parts, please give complete model and/or serial number.

# OPERATING AND MAINTENANCE INSTRUCTIONS FOR OIL-LESS PISTON COMPRESSORS AND VACUUM PUMPS

**CAUTION:** Never lubricate this dry oil-less piston pump. The Teflon® filled rings are self-lubricating and require no oil. The motor bearings are grease packed for the life of the bearing.

**GUARANTEE:** Gast products are guaranteed against defects in material or workmanship (normal wear of parts excluded) for a period of one year from date of shipment from factory. Units failing within warranty will be rebuilt or replaced at Gast's discretion, F.O.B. factory.

**CLEANING:** This unit requires NO flushing. Dust off filter felts as they become dirty. To replace felts, remove the plastic jar. The felt is held in place by an end cap, and a rivet stud which can readily be pulled out.

**DIS-ASSEMBLY:** It is not necessary to remove the filters from the cylinder head as metal chips could be dislodged and enter the unit. Remove the shroud, cylinder head, and valve components. Do not re-arrange the valve components. Remove the cylinder and rings. Make sure all parts are clean before re-assembling. DO NOT use any chlorinated solvents to clean valves, or any liquids to flush units. THE STAINLESS STEEL VALVES MAY BE CLEANED WITH WATER. All parts, except the valves, can be cleaned with any industrial, non flammable, non toxic, cleaning solvent.

**ELECTRICAL:** Remove the plate covering the electrical terminal for wiring instructions.

**ASSEMBLY:** Install piston seals, piston rings, and rider rings on the piston. Locate ring joints approximately opposite each other. Attach cylinders to bracket with the cylinder screws and lock washers. Tighten screws finger tight. Move pistons to top dead center position. Adjust each cylinder flush with top of piston and torque cylinder screws to 85-90 lb. in. Re-torque second time. Stack the valve components in order as shown in the detail. The valve leaf is pre-bent and should not be adjusted in any way. Install the cylinder head, lock washers, and head screws. The **exhaust** ports in the cylinder head have been marked by omitting the ends of two of the fins. Do not tighten head screws at this time. Install manifold nuts and seals on the manifold and assemble into the elbow fitting, but do not tighten. Install second valve-head assembly on the other cylinder and manifold. Torque all head screws to 85-90 lb. in. Re-torque again. Position manifold and tighten manifold nut ½ to ¾ turns beyond hand tight.

**INSPECTION:** Regular inspection may prevent expensive repairs. Do not be alarmed if pump temperature reaches 150-250° F. when running continuously. If pump or motor shows evidence of overheating or excessive noise, stop immediately for repairs.

It is usually quickest and cheapest to send the motor in for repair. Authorized service facilities are located at:

Brenner-Fiedler and Associates
16210 Gundry Avenue
Paramount, CA 90723
213/636-3206

Gast Manufacturing Corporation
515 Washington Avenue
Carlstadt, NJ 07072
201/933-8484

Gast Manufacturing Corporation
2300 M-139
Benton Harbor, MI 49022
616/926-6171

# APPENDIX B
# INTEGRATED CIRCUITS

Table B1. Integrated Circuit Ampex Part Numbers

| AMPEX PART NO. | MANUFACTURER'S PART NO. | MANUFACTURER | PAGE NO. |
|---|---|---|---|
| 586-048 | F uA711HM | Fairchild | B-4 |
| 586-075 | MC 7400 | Motorola | B-4 |
| 586-076 | MC 7410 | Motorola | B-5 |
| 586-077 | MC 7420 | Motorola | B-5 |
| 586-078 | MC 7430 | Motorola | B-5 |
| 586-079 | MC 7440 | Motorola | B-6 |
| 586-106 | MC 7451 | Motorola | B-6 |
| 586-108 | SN 7474N | Texas Instruments | B-7 |
| 586-109 | MC 7402 | Motorola | B-7 |
| 586-121 | F u711HC | Fairchild | B-8 |
| 586-124 | F u71OHC | Fairchild | B-8 |
| 586-152 | MC 836P | Motorola | B-9 |
| 586-153 | MC 846P | Motorola | B-9 |
| 586-155 | MC 862P | Motorola | B-10 |
| 586-163 | SN 7454N | Texas Instruments | B-10 |
| 586-166 | SN 74H30N | Texas Instruments | B-11 |
| 586-167 | SN 74H10N | Texas Instruments | B-11 |
| 586-168 | SN 74H00N | Texas Instruments | B-12 |
| 586-176 | MC 7402 | Motorola | B-12 |
| 586-203 | CA 3028B | RCA | B-13 |
| 586-249 | CA 3028 A | RCA | B-14 |
| 586-253 | CA 3006 | RCA | B-15 |
| 586-255 | CA 3019 | RCA | B-16 |
| 586-257 | F 9301 | Fairchild | B-16 |
| 586-261 | LM 302 | National | B-17 |
| 586-268 | F 741PC | Fairchild | B-17 |
| 586-269 | F uA741 | Fairchild | B-18 |
| 586-274 | MC 844P | Motorola | B-18 |
| 586-276 | CA 3046 | RCA | B-19 |
| 586-282 | MC 1439G | Motorola | B-19 |
| 586-283 | MC 7493 | Motorola | B-20 |
| 586-287 | SN 74H51 | Texas Instruments | B-21 |
| 586-294 | F 9003DC | Fairchild | B-22 |
| 586-303 | F 9328 | Fairchild | B-23 |
| 586-309 | F 9601 | Fairchild | B-23 |
| 586-316 | CA 3039 | RCA | B-24 |
| 586-325 | SN 7405 | Texas Instruments | B-24 |

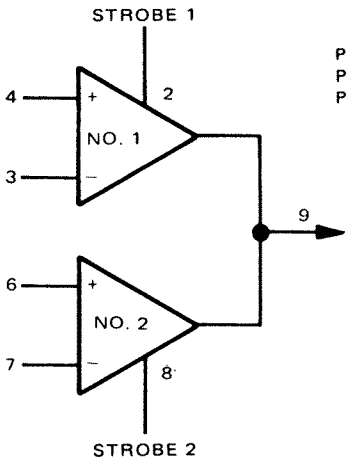
Table B1. Integrated Circuit Ampex Part Numbers (Continued)

| AMPEX PART NO. | MANUFACTURER'S PART NO. | MANUFACTURER | PAGE NO. |
|---|---|---|---|
| 586-326 | MC 7404 | Motorola | B-25 |
| 586-327 | SN 74H11 | Texas Instruments | B-25 |
| 586-335 | LM 306 | National | B-26 |
| 586-336 | DM 8800 | National | B-27 |
| 586-415 | MC 857P | Motorola | B-28 |
| 586-423 | MC 7442 | Motorola | B-28 |
| 586-425 | MC 853P | Motorola | B-28 |
| 586-437 | LM 301A | National | B-29 |
| 586-440 | F uA747 | Fairchild | B-29 |
| 586-442 | MC 858P | Motorola | B-30 |
| 586-445 | SN 7475 | Texas Instruments | B-30 |
| 586-447 | CA 3026 | RCA | B-31 |
| 586-450 | DM 8570 | National | B-31 |
| 586-473 | MC 1210L | Motorola | B-32 |
| 586-477 | MC 1216L | Motorola | B-32 |
| 586-485 | MC 1230L | Motorola | B-33 |
| 586-488 | MC 1234L | Motorola | B-33 |
| 586-489 | MC 1204L | Motorola | B-34 |
| 586-492 | SN 7496N | Texas Instruments | B-35 |
| 586-509 | F 9311 | Fairchild | B-36 |
| 586-533 | SN 74121 | Texas Instruments | B-37 |
| 586-544 | SN 7483 | Texas Instruments | B-38 |
| 586-581 | SN 7403N | Texas Instruments | B-38 |
| 586-617 | F 9602DC | Fairchild | B-39 |
| 586-647 | MC 74107 | Motorola | B-40 |
| 586-685 | N 74H01A | Signetics | B-41 |
| 586-688 | SN 74H04N | Texas Instruments | B-41 |
| 586-700 | SN 74H74N | Texas Instruments | B-42 |
| 586-705 | SN 7486 | Texas Instruments | B-42 |
| 586-713 | F 7407PC | Fairchild | B-42 |
| 586-738 | SN 74H20N | Texas Instruments | B-43 |
| 586-759 | SN 7408N | Texas Instruments | B-43 |
| 586-778 | F CA 3054 | Fairchild | B-43 |
| 586-797 | SN 74123 | Texas Instruments | B-44 |
| 586-7900 | SN 74192 | Texas Instruments | B-45 |
| 586-800 | SN 74193 | Texas Instruments | B-46 |
| 586-830 | SN 74S00N | Texas Instruments | B-47 |
| 586-870 | SN 74197N | Texas Instruments | B-48 |
| 586-903 | F 9322 | Fairchild | B-49 |
| 586-910 | SN 7437N | Texas Instruments | B-49 |
| 586-917 | F 7427PC | Fairchild | B-50 |
| 586-918 | DM 7432N | National Semiconductor | B-50 |
| 586-919 | SN 7489 | Texas Instruments | B-51 |
| 586-923 | SN 74163 | Texas Instruments | B-52 |
| 587-033 | SN 74170 | Texas Instruments | B-53 |

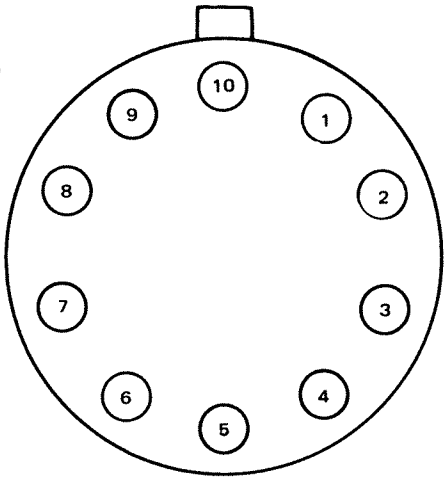
Table B1. Integrated Circuit Ampex Part Numbers (Continued)

| AMPEX PART NO. | MANUFACTURER'S PART NO. | MANUFACTURER | PAGE NO. |
|---|---|---|---|
| 587-040 | F 93410DC | Fairchild | B-54 |
| 587-051 | SN 7425N | Texas Instruments | B-55 |
| 587-093 | N 2502B | Signetics | B-56 |
| 587-157 | DAC-01-HX | Precision Monolithic | B-57 |
| 587-163 | MC 1330P | Motorola | B-58 |
| 587-164 | MC 1350P | Motorola | B-59 |
| 587-168 | CD 4016AE | RCA | B-60 |
| 587-169 | HAZ-911-5 | Harris | B-60 |
| 587-170 | HAZ-2605-5 | Harris | B-61 |
| 587-217 | DG 200BA | Siliconix | B-62 |
| 587-240 | HAZ-2625-5 | Harris | B-63 |

| FAIRCHILD<br>Fμ 711 HM | AMPEX<br>586-048 | DUAL<br>COMPARATOR |
|---|---|---|

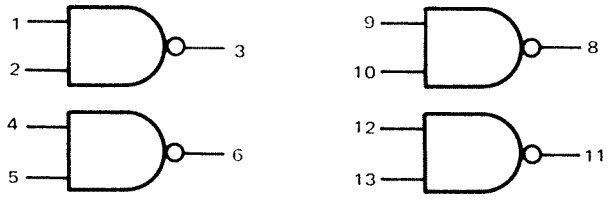



PIN 1 = GND
PIN 5 = −6V (−V)
PIN 10 = +12V (+V)



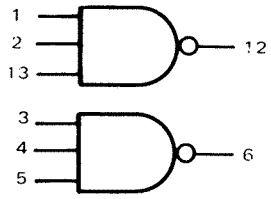

BOTTOM VIEW

| MOTOROLA<br>MC 7400 | AMPEX<br>586-075 | QUAD 2-INPUT<br>NAND GATE |
|---|---|---|




PIN 7 = GND
PIN 14 = $V_{CC}$ (+5V)
3 = $\overline{1.2}$

| TEXAS INSTRUMENTS<br>SN 7410 N | AMPEX<br>586-076 | 3-INPUT<br>NAND GATE |
|---|---|---|

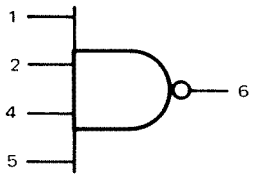


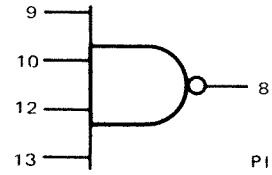




PIN 7 = GND
PIN 14 = $V_{cc}$
12 = $\overline{1.2.13}$

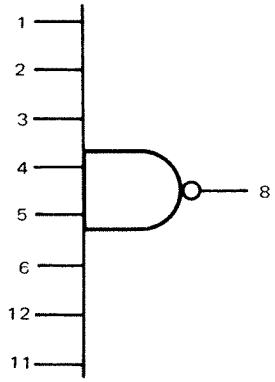
| TEXAS INSTRUMENTS<br>SN 7420 N | AMPEX<br>586-077 | 4-INPUT<br>NAND GATE |
|---|---|---|




PIN 7 = GND
PIN 14 = $V_{cc}$
6 = $\overline{1.2.4.5}$

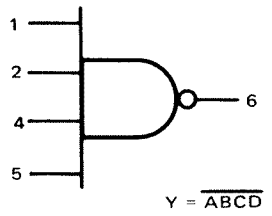
| TEXAS INSTRUMENTS<br>SN 7430 N | AMPEX<br>586-078 | 8-INPUT<br>NAND GATE |
|---|---|---|



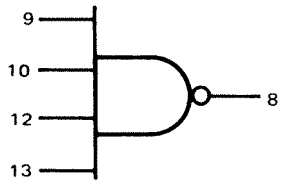

PIN 7 = GND
PIN 14 = $V_{cc}$

$8 = \overline{(1)(2)(3)(4)(5)(6)(11)(12)}$

| TEXAS INSTRUMENTS<br>SN 7440 N | AMPEX<br>586-079 | DUAL 4-INPUT<br>NAND GATE |
|---|---|---|

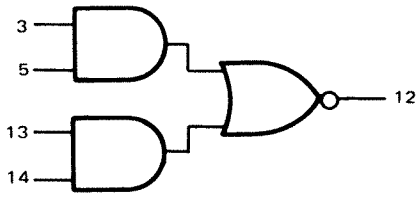



$Y = \overline{ABCD}$



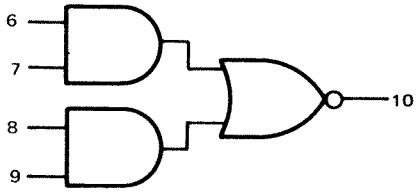

PIN 7 = GND
PIN 14 = $V_{CC}$
TOTEM OUTPUT

| MOTOROLA<br>MC 7451 | AMPEX<br>586-106 | DUAL 2-WIDE 2-INPUT<br>AND-OR-INVERT GATE |
|---|---|---|

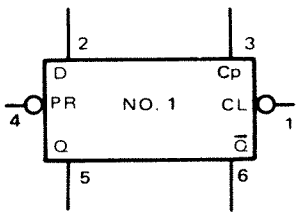


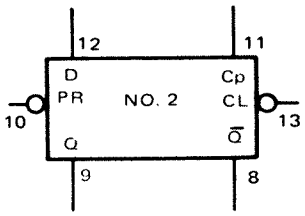

$12 = \overline{(3.5)+(13.14)}$

PIN 4 = $V_{CC}$ (5V)
PIN 11 = GND



| TEXAS INSTRUMENTS<br>SN 7474 | AMPEX<br>586-108 | DUAL D-TYPE EDGE-<br>TRIGGERED FLIP-FLOP |
|---|---|---|




PIN 7 = GND
PIN 14 = $V_{cc}$

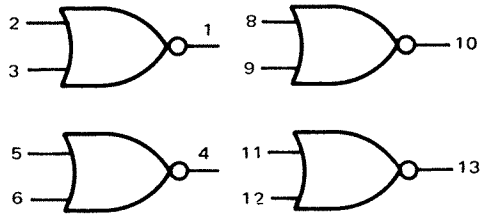
PR = PRESET
CL = CLEAR
Cp = CLOCK

| $t_n$ D | $t_n + 1$ Q |
|---|---|
| L | L |
| H | H |

| PR | CL | Q |
|---|---|---|
| L | H | H |
| H | L | L |
| L | L | ND |

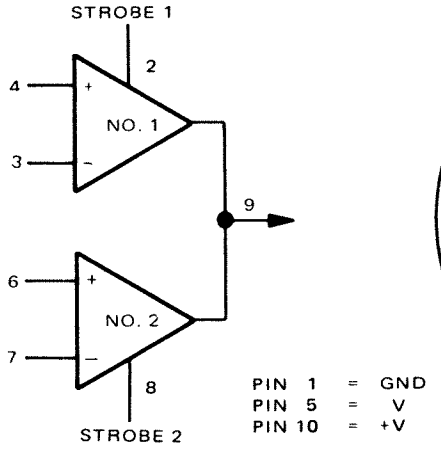
$t_n + 1$ IS TIME AFTER POSITIVE TRANSITION OF CLOCK

| MOTOROLA<br>MC 7402 | AMPEX<br>586-109 | QUAD 2-INPUT<br>NOR GATE |
|---|---|---|

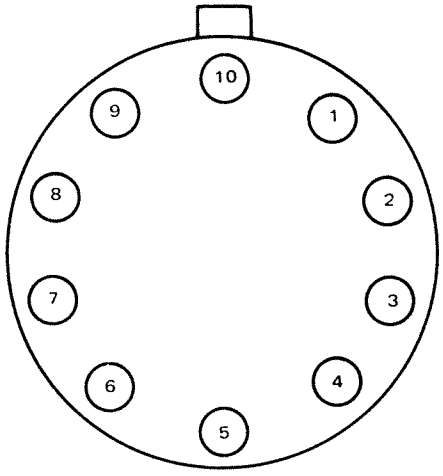



1 = $\overline{2+3}$
PIN 7 = GND
PIN 14 = $V_{cc}$ (5V)

| FAIRCHILD<br>Fμ 711 HC | AMPEX<br>586-121 | DUAL<br>COMPARATOR |
|---|---|---|

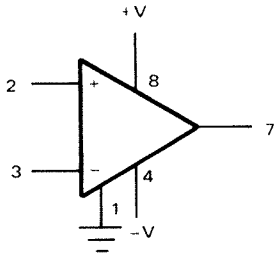


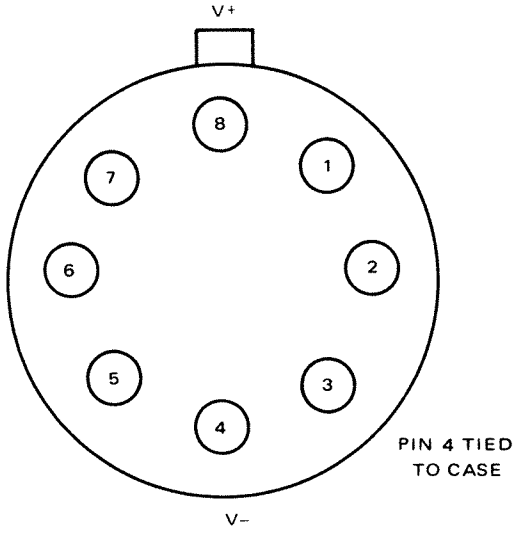

PIN 1 = GND
PIN 5 = V
PIN 10 = +V




BOTTOM VIEW

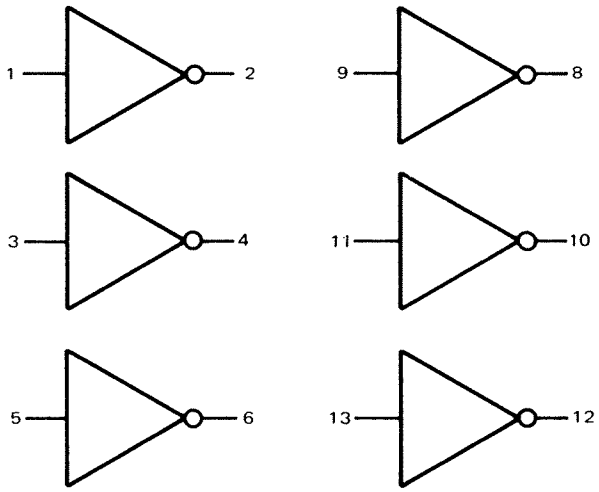
| FAIRCHILD<br>Fμ 710 HC | AMPEX<br>586-124 | HIGH-SPEED<br>DIFFERENTIAL<br>COMPARATOR |
|---|---|---|



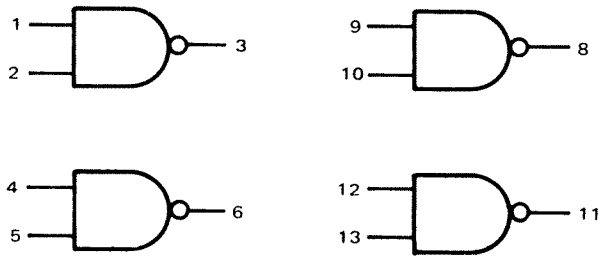

BOTTOM VIEW

| MOTOROLA<br>MC 836 P | AMPEX<br>586-152 | HEX<br>INVERTER |
|---|---|---|




$2 = \overline{1}$
H = L
L = H
PIN 14 = +5V
PIN 7 = GND

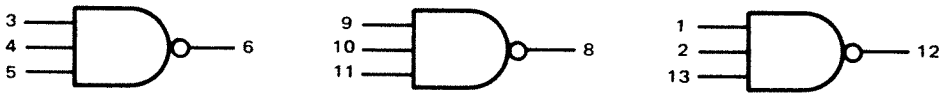
| MOTOROLA<br>MC 846 P | AMPEX<br>586-153 | QUAD 2-INPUT<br>NAND GATE |
|---|---|---|




$3 = \overline{1} + \overline{2}$
H = L + L
L = H · H

PIN 7 = GND
PIN 14 = +5V

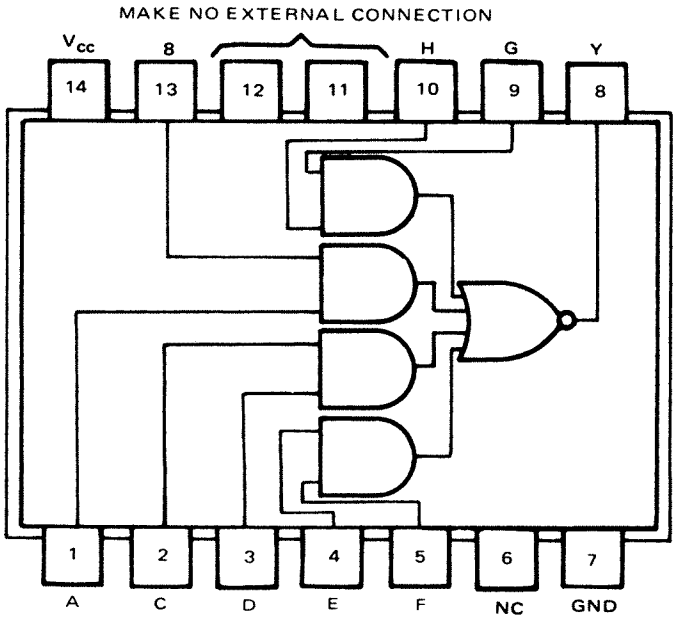
| MOTOROLA<br>MC 862 P | AMPEX<br>586-155 | TRIPLE 3-INPUT<br>NAND GATE |
|---|---|---|




$6 = \overline{3} + \overline{4} + \overline{5}$
H = L + L + L
L = H · H · H

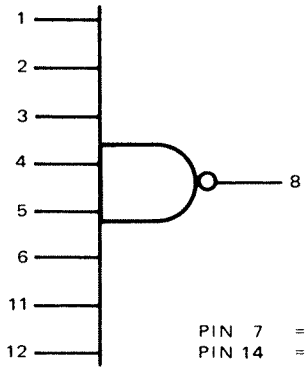
PIN 14 = +5V
PIN 7 = GND

| TEXAS INSTRUMENTS<br>SN 7454 N | AMPEX<br>586-163 | 4-WIDE<br>AND-OR-INVERT GATES |
|---|---|---|




$Y = \overline{AB+CD+EF+GH}$

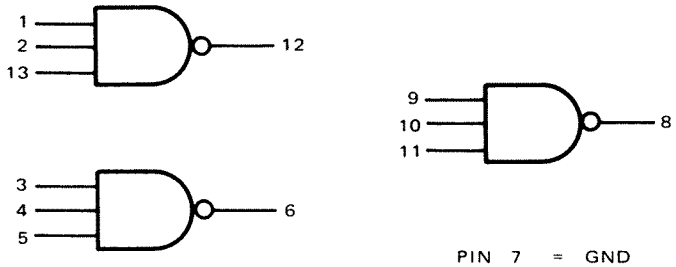
| TEXAS INSTRUMENTS<br>SN 74 H 30 N | AMPEX<br>586-166 | 8-INPUT<br>NAND GATE |
|---|---|---|




PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

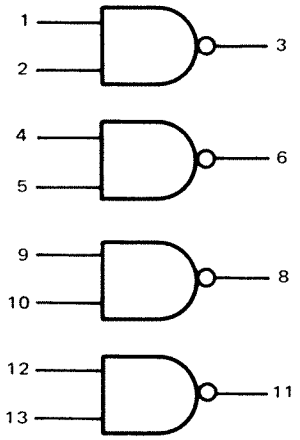
$8 = \overline{(1)(2)(3)(4)(5)(6)(11)(12)}$

| TEXAS INSTRUMENTS<br>SN 74H10N | AMPEX<br>586-167 | 3-INPUT<br>NAND GATE |
|---|---|---|



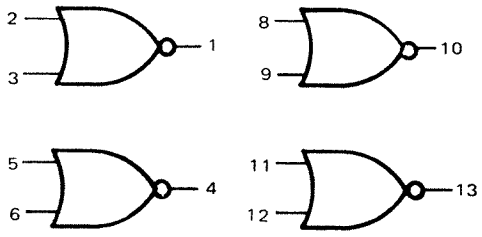

PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

| TEXAS INSTRUMENTS<br>SN 74H00 N | AMPEX<br>586-168 | QUAD 2-INPUT<br>NAND GATE |
|---|---|---|



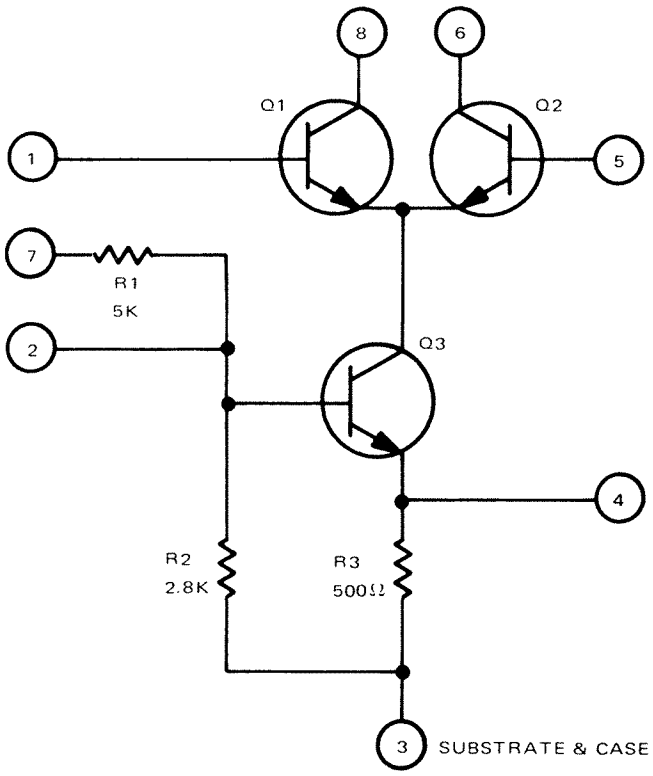

PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

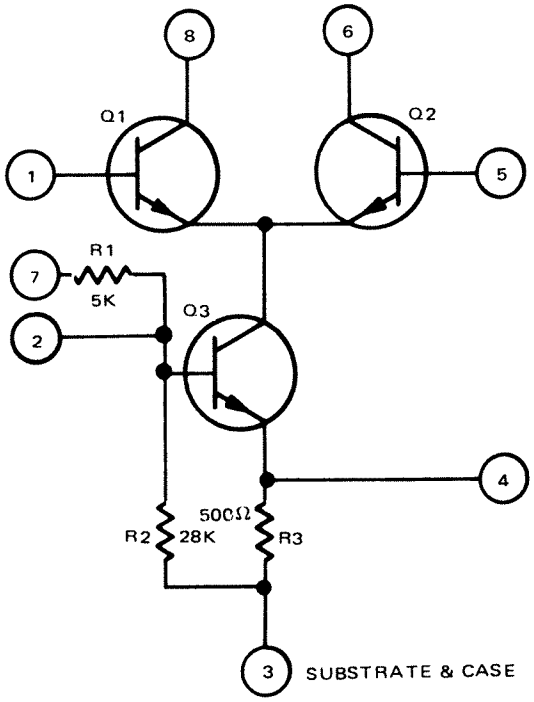
| MOTOROLA<br>MC 7402 | AMPEX<br>586-176 | QUAD 2-INPUT<br>NOR GATE |
|---|---|---|

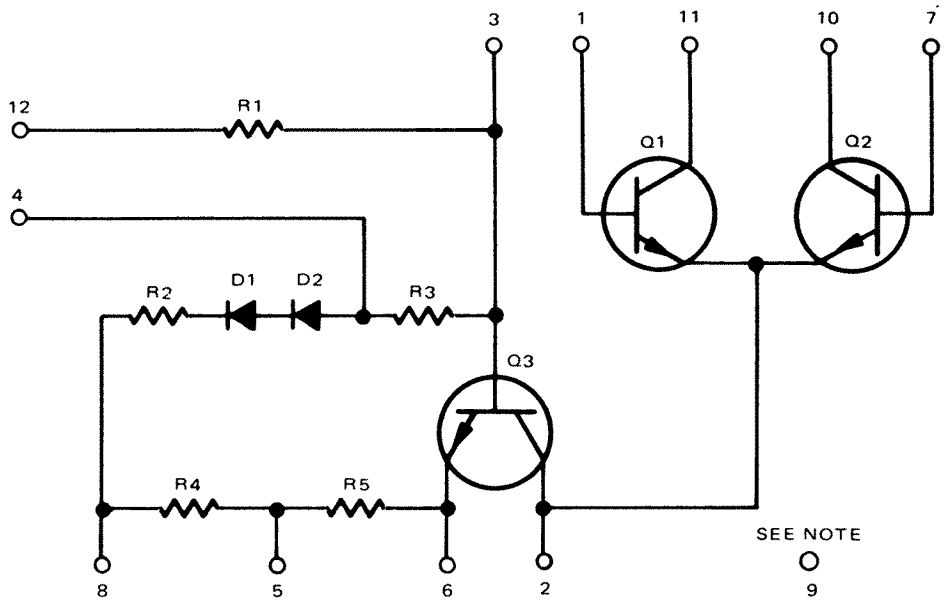



$1 = \overline{2+3}$

PIN 7 = GND
PIN 14 = $V_{cc}$ (5V)

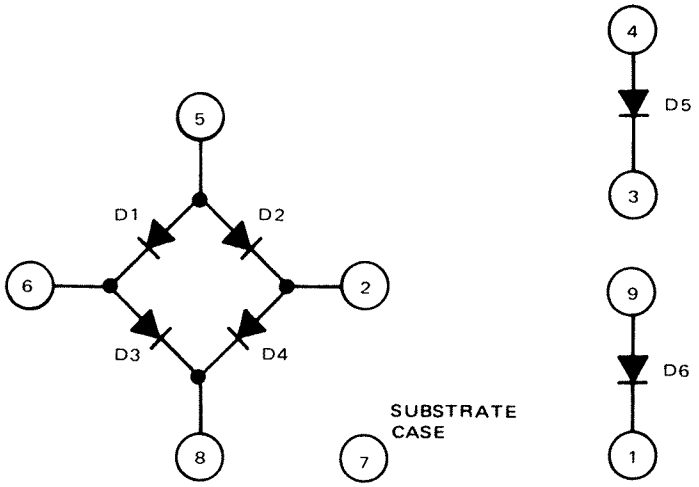

8
6
Q1
Q2
1
5
7
R1
5K
2
Q3
4
R2
2.8K
R3
500Ω
3
SUBSTRATE & CASE


8
6
Q1
Q2
1
5
R1
7
5K
Q3
2
4
500Ω
R2
28K
R3
3
SUBSTRATE & CASE



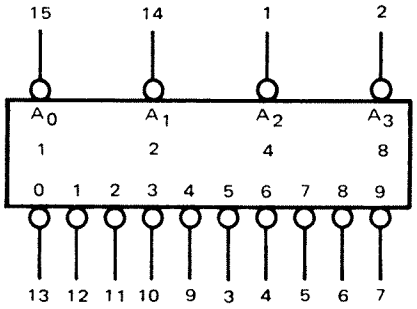

NOTE: TERMINAL NO. 9 IS CONNECTED TO MOST POSITIVE DC SUPPLY VOLTAGE USED FOR CIRCUIT.

| RCA<br>CA 3019 | AMPEX<br>586-255 | DIODE<br>ARRAY |
|---|---|---|




* CONNECT TO MOST NEGATIVE CIRCUIT POTENTIAL.

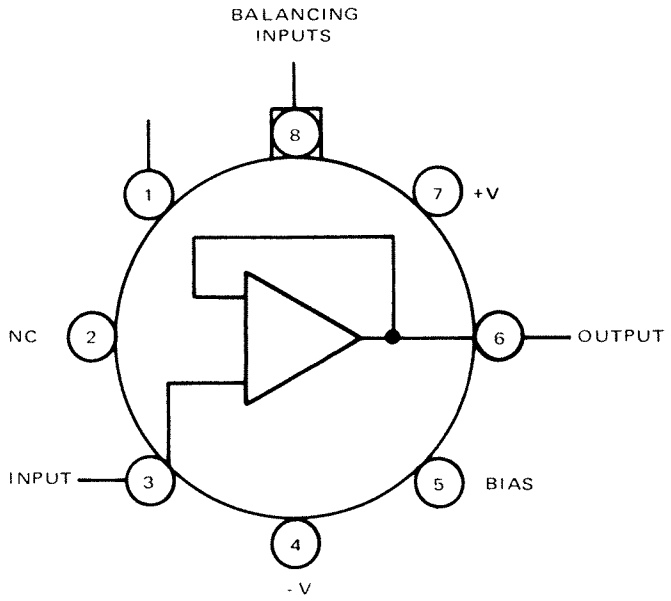
| FAIRCHILD<br>Fμ 9301 DC | AMPEX<br>586-257 | BCD TO<br>1 OF 10 DECODER |
|---|---|---|




PIN 16 = +5V
PIN 8 = GND

| $A_0$ | $A_1$ | $A_2$ | $A_3$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | L | L | L | L | H | H | H | H | H | H | H | H | H |
| H | L | L | L | H | L | H | H | H | H | H | H | H | H |
| L | H | L | L | H | H | L | H | H | H | H | H | H | H |
| H | H | L | L | H | H | H | L | H | H | H | H | H | H |
| L | L | H | L | H | H | H | H | L | H | H | H | H | H |
| H | L | H | L | H | H | H | H | H | L | H | H | H | H |
| L | H | H | L | H | H | H | H | H | H | L | H | H | H |
| H | H | H | L | H | H | H | H | H | H | H | L | H | H |
| L | L | L | H | H | H | H | H | H | H | H | H | L | H |
| H | L | L | H | H | H | H | H | H | H | H | H | H | L |
| L | H | L | H | H | H | H | H | H | H | H | H | H | H |
| H | H | L | H | H | H | H | H | H | H | H | H | H | H |
| L | L | H | H | H | H | H | H | H | H | H | H | H | H |
| H | L | H | H | H | H | H | H | H | H | H | H | H | H |
| L | H | H | H | H | H | H | H | H | H | H | H | H | H |
| H | H | H | H | H | H | H | H | H | H | H | H | H | H |

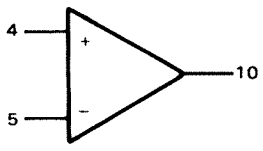
| NATIONAL SEMICONDUCTOR<br>LM 302 H | AMPEX<br>586-261 | VOLTAGE<br>FOLLOWER |
|---|---|---|




NOTE: PIN 4 CONNECTED TO CASE

PIN 4 = -18V (-V), MAX
PIN 7 = +18V (+V), MAX

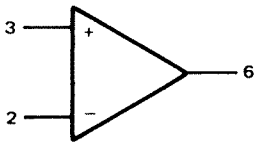
| FAIRCHILD<br>FC 741 PC | AMPEX<br>586-268 | OPERATIONAL<br>AMPLIFIER |
|---|---|---|




1,2,7,8
12,13,14 NO CONNECTION

PIN 6 = -SUPPLY
PIN 11 = +SUPPLY

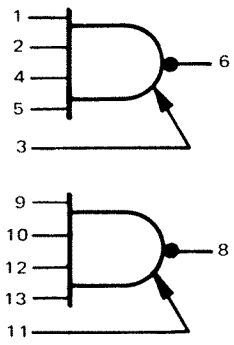
| FAIRCHILD<br>FC 741 HC | AMPEX<br>586-269 | OPERATIONAL<br>AMPLIFIER |
|---|---|---|




PIN 1 = OFFSET NULL

PIN 4 = −V (CASE)
PIN 5 = OFFSET NULL
PIN 7 = +V
PIN 8 = NC

| MOTOROLA<br>MC 844 P | AMPEX<br>586-274 | EXPANDABLE DUAL<br>4-INPUT POWER GATE<br>(OPEN COLLECTOR) |
|---|---|---|

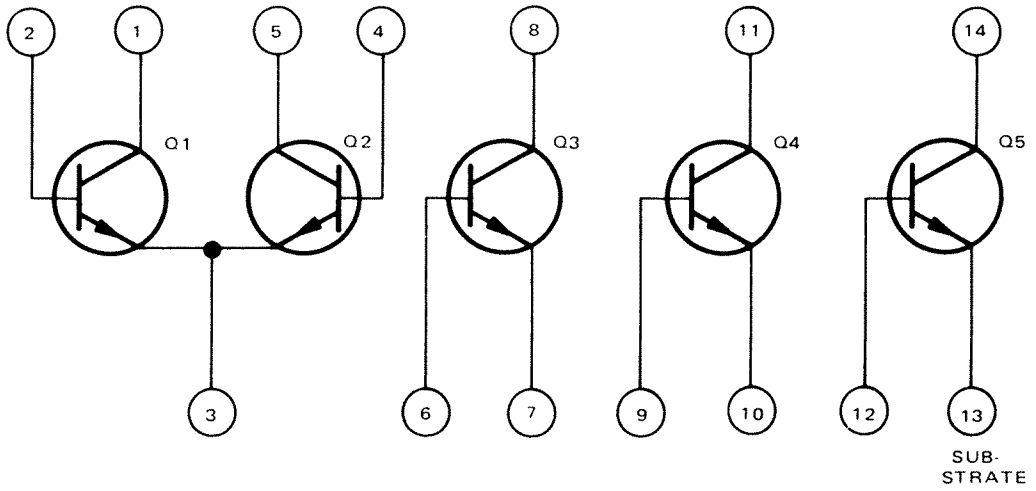



$6 = \bar{1} + \bar{2} + \bar{4} + \bar{5} + (\bar{3})$

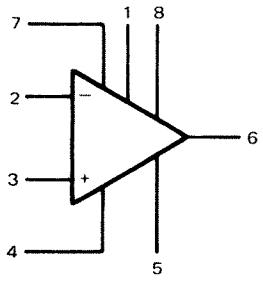
| 6 | $\bar{1}$ | | $\bar{2}$ | | $\bar{4}$ | | $\bar{5}$ | | $(\bar{3})$ |
|---|---|---|---|---|---|---|---|---|---|
| H | L | + | L | + | L | + | L | + | L |
| L | H | · | H | · | H | · | H | · | (3) |

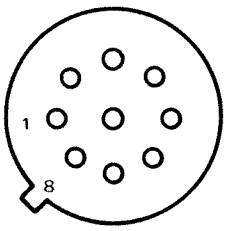
PIN 7 = GND
PIN 14 = +5V

| RCA<br>CA 3046 | AMPEX<br>586-276 | GENERAL PURPOSE<br>TRANSISTOR ARRAY |
|---|---|---|




| MOTOROLA<br>MC 1439 G | AMPEX<br>586-282 | OPERATIONAL<br>AMPLIFIER |
|---|---|---|



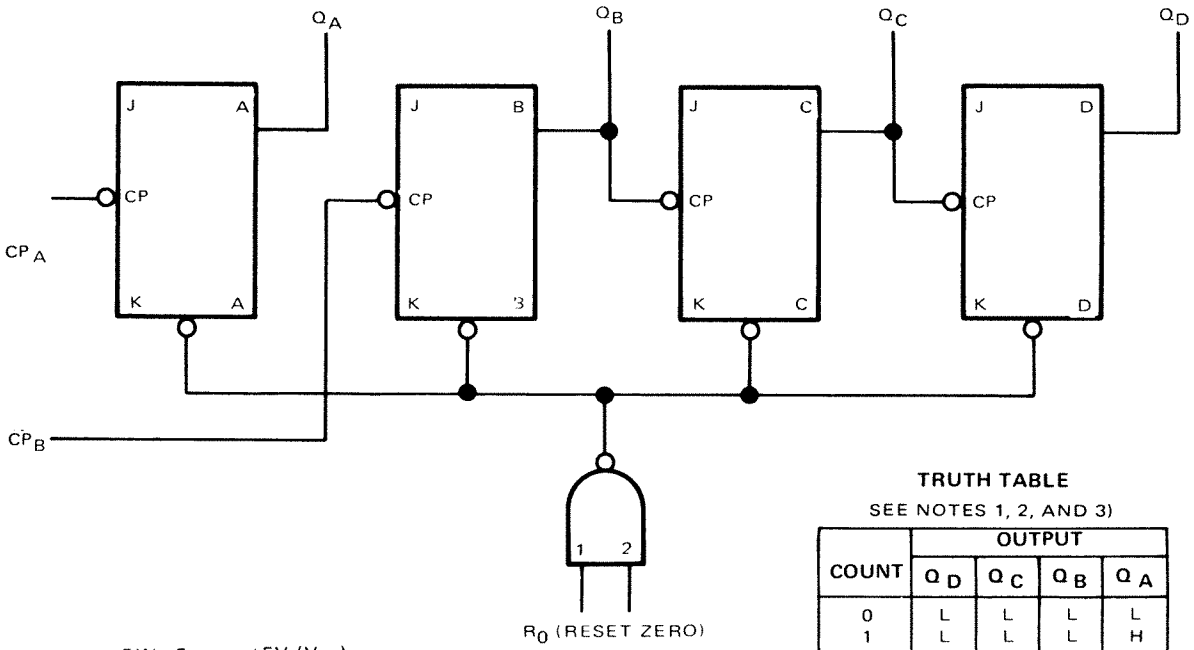




G SUFFIX METAL PACKAGE
CASE 601, TO-99

PIN 7 = V+
PIN 4 = V- (CASE)
PIN 2 = INVERT IN
PIN 3 = NON-INVERT IN
PIN 1,8 = INPUT LAG
PIN 5 = OUTPUT LAG
PIN 6 = OUTPUT

FREQ. COMP.

| TEXAS INSTRUMENTS<br>SN 7493 N | AMPEX<br>586-283 | 4-BIT<br>BINARY COUNTER |
|---|---|---|

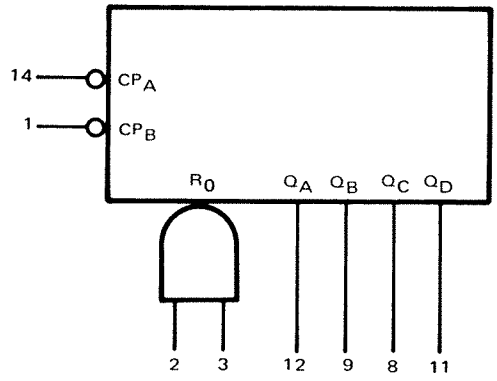



**TRUTH TABLE**

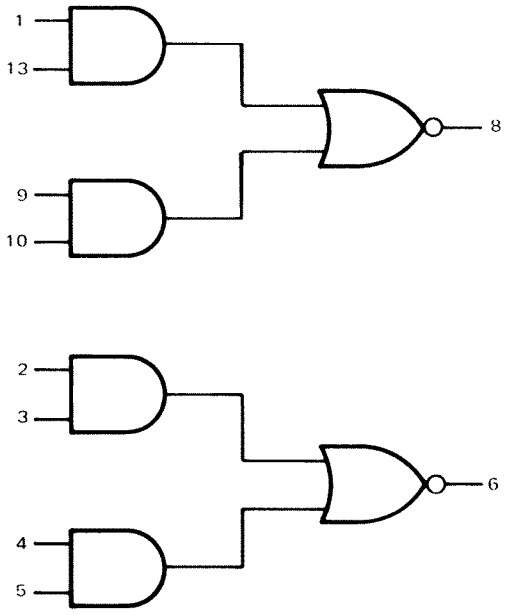
SEE NOTES 1, 2, AND 3)

| COUNT | OUTPUT | | | |
|---|---|---|---|---|
| | $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |
| 10 | H | L | H | L |
| 11 | H | L | H | H |
| 12 | H | H | L | L |
| 13 | H | H | L | H |
| 14 | H | H | H | L |
| 15 | H | H | H | H |

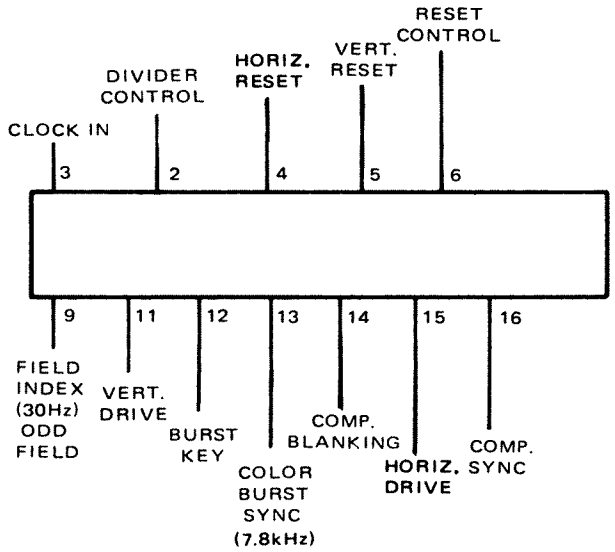
PIN 5 = +5V ($V_{cc}$)
PIN 10 = GND
PIN 4, 6, 7, 13 = NC




NOTES:
1. OUTPUT $Q_A$ CONNECTED TO INPUT $\overline{CP}_B$.
2. TO RESET ALL OUTPUTS TO LOW LEVEL BOTH $R_{0(1)}$ AND $R_{0(2)}$ INPUTS MUST BE AT HIGH LEVEL STATE.
3. EITHER (OR BOTH) RESET INPUTS $R_{0(1)}$ AND $R_{0(2)}$ MUST BE AT A LOW LEVEL TO COUNT.




| | |
|---|---|
| PIN 7 | GND |
| PIN 14 | +5V ($V_{cc}$) |
| PIN 11 | NC |
| PIN 12 | NC |

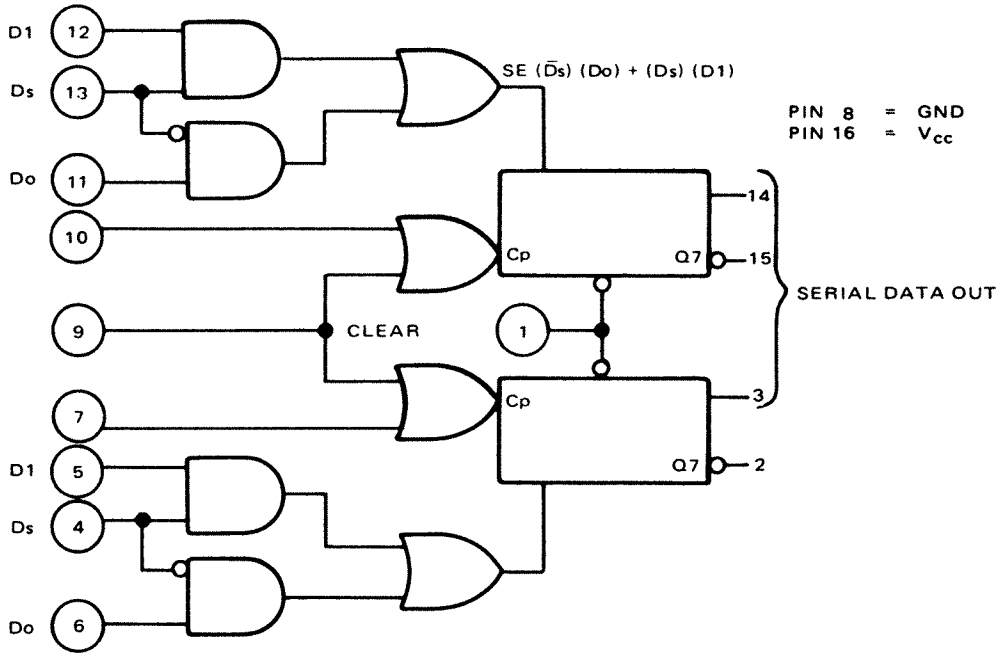



PIN 2: DIVIDER CONTROL –12 MASTER CLOCK 1.26MHz (80 x H)
DIVIDER CONTROL +5 MASTER CLOCK 2.04545 MHz

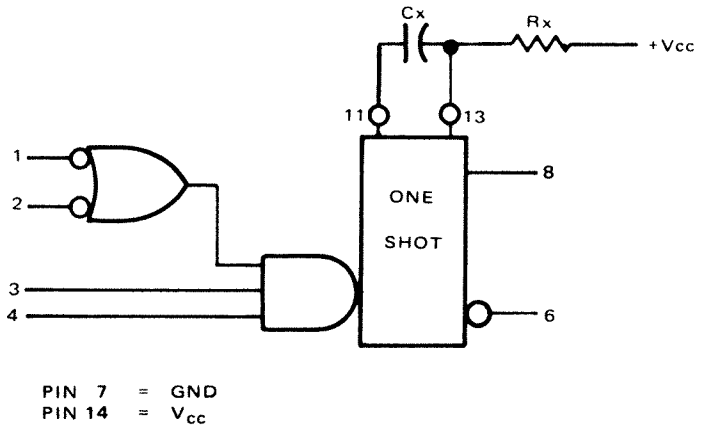
PIN 6: RESET CONTROL LOW VERT. RESET AT 5th SERRATION
HIGH RESET TO 0 COUNT (START OF VERTICAL BLANKING)

PIN 1 = $V_{gg}$ (–12V)
PIN 8 = $V_{ss}$ (+5V)

| FAIRCHILD<br>FC 9328 DC | AMPEX<br>586-303 | DUAL 8-BIT<br>SHIFT REGISTER |
|---|---|---|




| FAIRCHILD<br>FC 9601 DC | AMPEX<br>586-309 | RETRIGGERABLE<br>MONOSTABLE MULTIVIBRATOR<br>(ONE SHOT) |
|---|---|---|




PW 0.36 Rx Cx

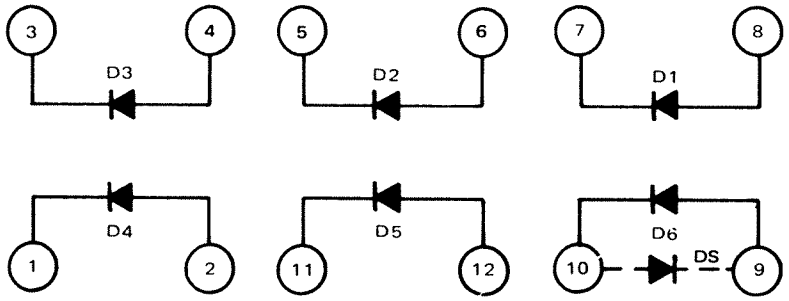
T(ns) 0.32 Rx Cx (1 + 0.7/Rx)

Cx IN ρF
Rx IN K

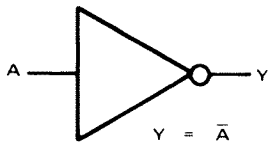
WITH TRANSISTOR OR DIODE
ACROSS Cx (WHEN LARGE VALUES ARE USED):

T(ns) = 0.36 Cx Rx (1 + 0.7/Rx)

| RCA<br>CA 3039 | AMPEX<br>586-316 | DIODE ARRAY<br>12 LEAD TO 5 |
|---|---|---|



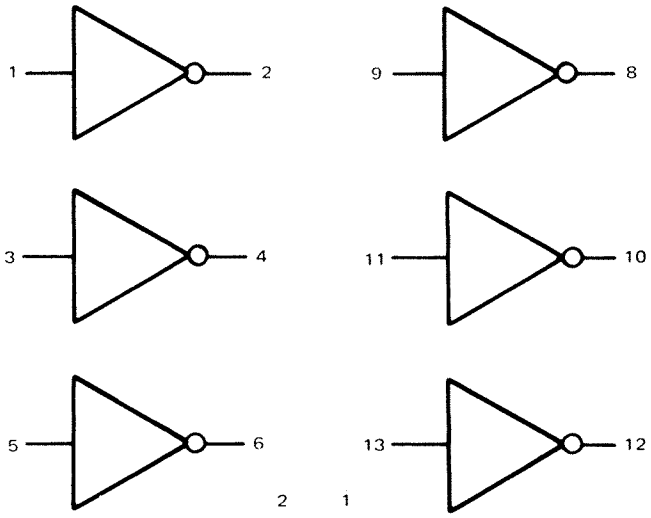

| TEXAS INSTRUMENTS<br>SN 7405 N | AMPEX<br>586-325 | HEX INVERTER<br>OPEN COLLECTOR |
|---|---|---|




| A | 1 | 3 | 5 | 9 | 11 | 13 |
|---|---|---|---|---|---|---|
| Y | 2 | 4 | 6 | 8 | 10 | 12 |

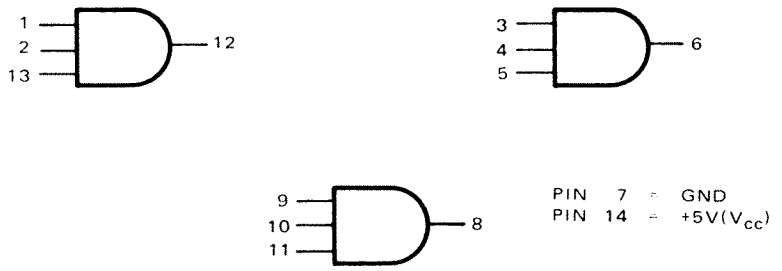
PIN 7 = GND
PIN 14 = $V_{cc}$

| MOTOROLA<br>MC 7404 | AMPEX<br>586-326 | HEX<br>INVERTER |
|---|---|---|



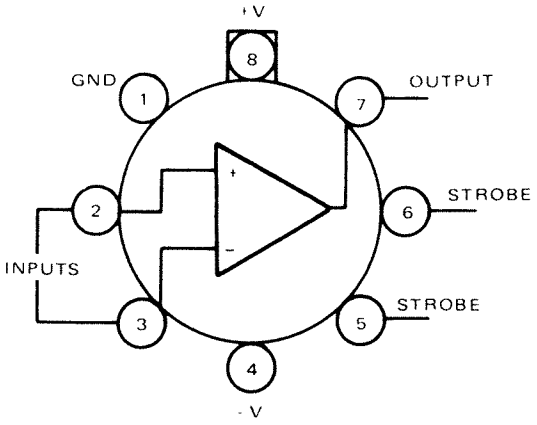

PIN 7 = GND
PIN 14 = $V_{cc}$ (5V)

| TEXAS INSTRUMENTS<br>SN 74H11 | AMPEX<br>586-327 | TRIPLE<br>3-INPUT AND GATE |
|---|---|---|



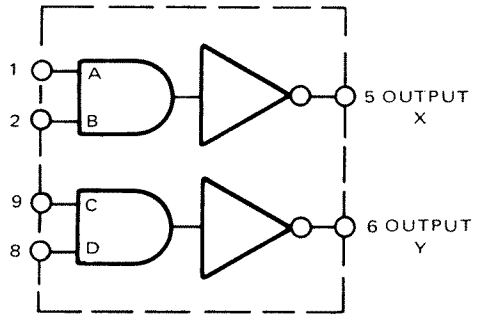

PIN 7 = GND
PIN 14 = +5V($V_{cc}$)

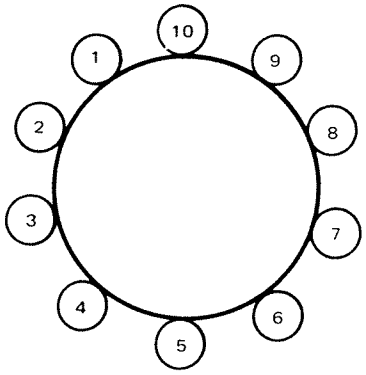
| NATIONAL SEMICONDUCTOR<br>LM 306 | AMPEX<br>586-335 | VOLTAGE<br>COMPARATOR/<br>BUFFER |
|---|---|---|




PIN 1 = GND
PIN 4 = -15V (–V), MAX
PIN 8 = +15V (+V), MAX

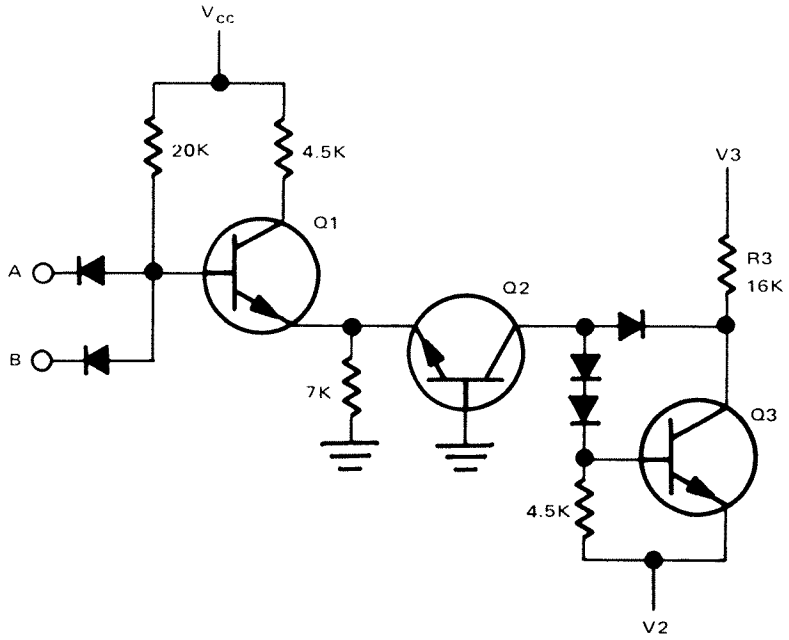
NOTE: PIN 4 CONNECTED TO CASE



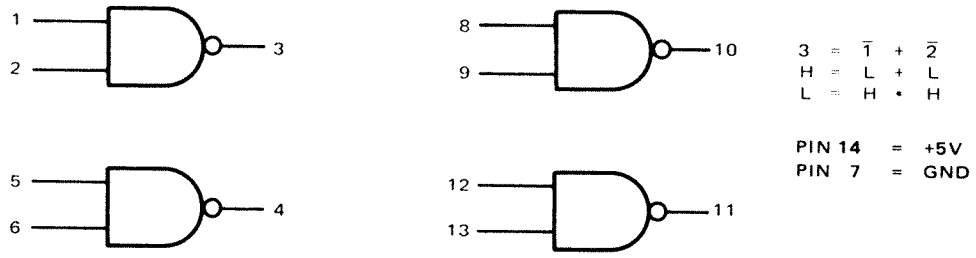




TOP VIEW

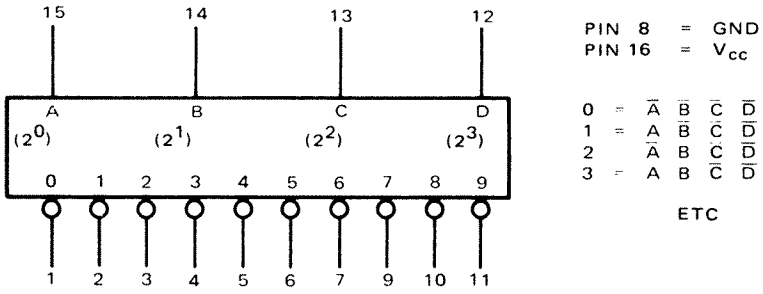
PIN 3 GND
PIN 4 +30V (V3), MAX
PIN 7 -30V (V2), MAX
PIN 10 +7V ($V_{cc}$), MAX



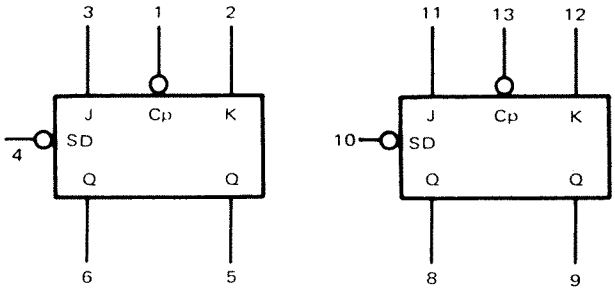
| MOTOROLA<br>MC 857 P | AMPEX<br>586-415 | QUAD 2-INPUT<br>NAND GATE |
|---|---|---|



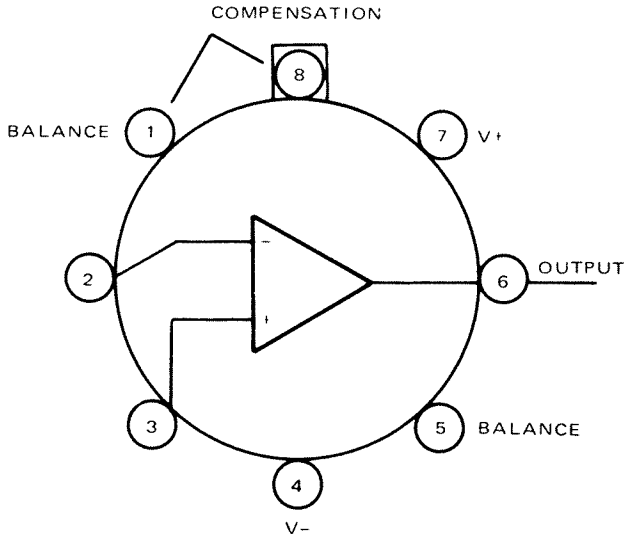

| TEXAS INSTRUMENTS<br>SN 7442 | AMPEX<br>586-423 | BCD TO<br>DECIMAL |
|---|---|---|




| MOTOROLA<br>MC 853 P | AMPEX<br>586-425 | DUAL J-K<br>FLIP-FLOP |
|---|---|---|

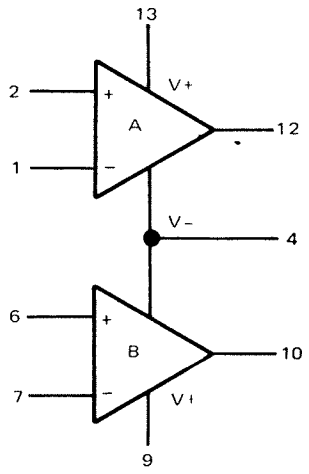


| NATIONAL SEMICONDUCTOR<br>LM 301 A | AMPEX<br>586-437 | OPERATIONAL<br>AMPLIFIER |
|---|---|---|



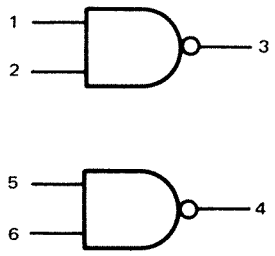

TOP VIEW

| FAIRCHILD<br>FC 747 DC | AMPEX<br>586-440 | DUAL OPERATIONAL<br>AMPLIFIER |
|---|---|---|




PIN 3 = OFFSET NULL A
PIN 5 = OFFSET NULL B
PIN 8 = OFFSET NULL B
PIN 14 = OFFSET NULL A
PIN 11 = NO CONNECTION

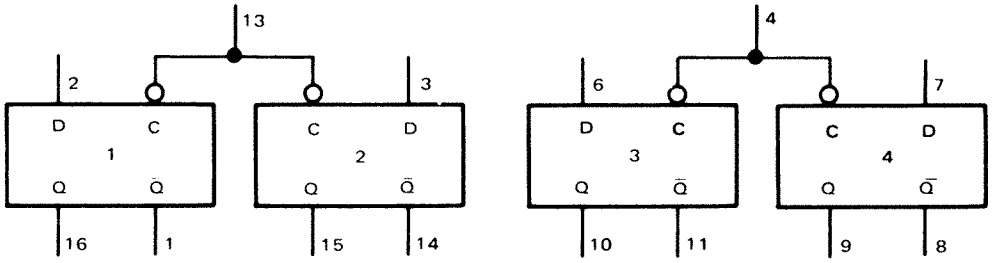
| MOTOROLA<br>MC 858 P | AMPEX<br>586-442 | QUAD 2-INPUT<br>NAND POWER GATE<br>(OPEN COLLECTOR) |
|---|---|---|




$3 = \overline{1} + \overline{2}$
H = L + L
L = H • H

PIN 14 = +5V
PIN 7 = GND

| TEXAS INSTRUMENTS<br>SN 7475 | AMPEX<br>586-445 | 4-BIT<br>BISTABLE LATCH |
|---|---|---|

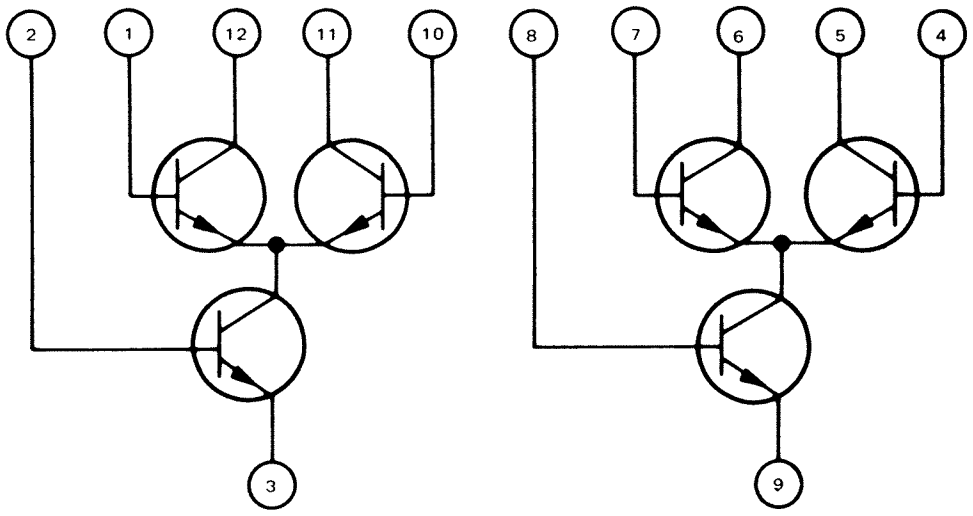



(TEMPORARY STORAGE)

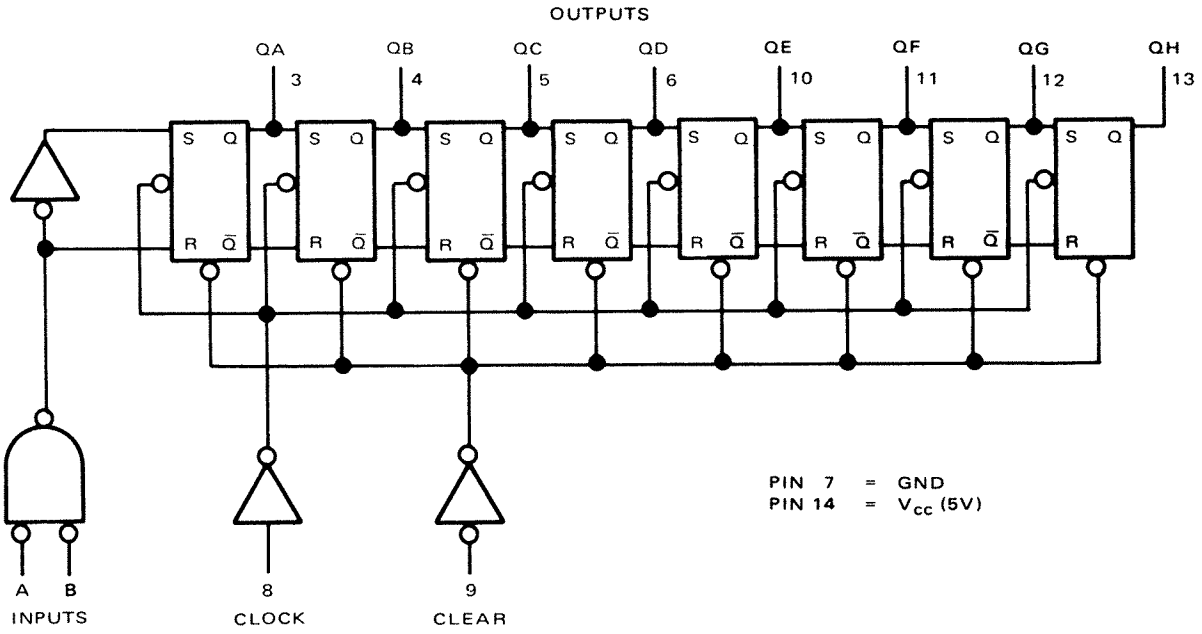
| D | C | Q | $\bar{Q}$ | |
|---|---|---|---|---|
| H | H | H | L | |
| L | H | L | H | |
| H | L | Q | | NO CHANGE |
| L | L | Q | | |

Q FOLLOWS DATA (D) INPUT AS LONG AS CLOCK (C) OR ENABLE - INPUT IS HIGH.
IF CLOCK (C) INPUT LOW, OUTPUT REMAINS IN SAME CONDITION IT WAS PRIOR TO NEGATIVE TRANSITION OF CLOCK (C) INPUT.

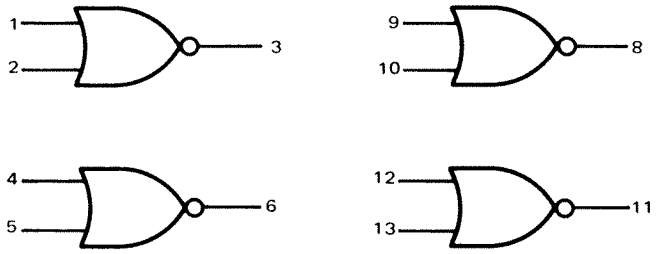
| RCA<br>CA 3026 | AMPEX<br>586-447 | DUAL DIFFERENTIAL<br>AMPLIFIER |
|---|---|---|




| TEXAS INSTRUMENTS<br>SN 74164 | AMPEX<br>586-450 | 8-BIT PARALLEL OUT<br>SERIAL SHIFT REGISTER |
|---|---|---|



| MOTOROLA<br>MC 1210 L | AMPEX<br>586-473 | QUAD 2-INPUT<br>NOR GATE |
|---|---|---|

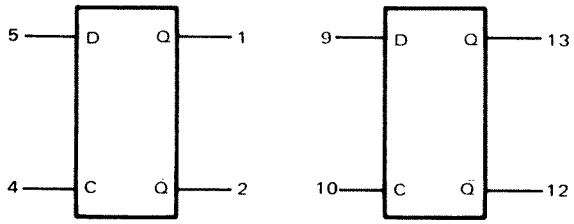



$3 = \overline{1 + 2}$

| | | | | |
|---|---|---|---|---|
| H | | L | · | L |
| L | - | H | + | H |

PIN 7 = -5.2V ($V_{ee}$)
PIN 14 = GND ($V_{cc}$)

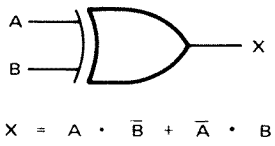
| MOTOROLA<br>MC 1216 L | AMPEX<br>586-477 | POSITIVE CLOCK ENABLE<br>SINGLE RAIL<br>R. S. FLIP-FLOP |
|---|---|---|




| D | C | Qn |
|---|---|---|
| L | L | Qn |
| H | L | Qn |
| L | H | L |
| H | H | H |

PIN 7 = -5.2V ($V_{ee}$)
PIN 14 = GND ($V_{cc}$)

| MOTOROLA<br>MC 1230 L | AMPEX<br>586-485 | QUAD EXCLUSIVE<br>OR GATES |
|---|---|---|

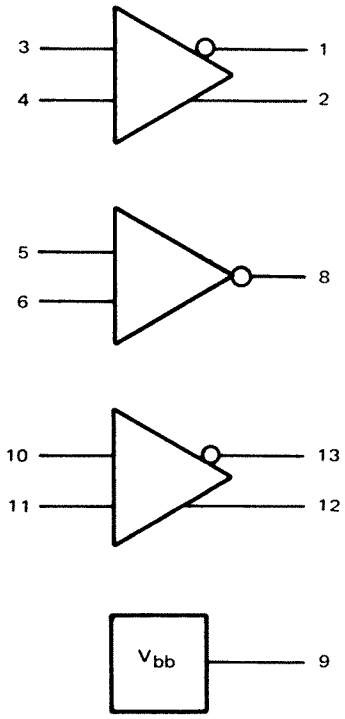



$X = A \cdot \overline{B} + \overline{A} \cdot B$

PIN 7 = −5.2V
PIN 14 = GND

| | IN | | OUT |
|---|---|---|---|
| | A | B | X |
| PINS | 1 | 3 | 2 |
| | 6 | 4 | 5 |
| | 8 | 10 | 9 |
| | 13 | 11 | 12 |
| | L | L | L |
| | H | L | H |
| | L | H | H |
| | H | H | L |

| MOTOROLA<br>MC 1235 L | AMPEX<br>586-488 | TRIPLE<br>DIFFERENTIAL<br>AMPLIFIER |
|---|---|---|

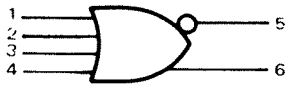



| IN | | OUT | |
|---|---|---|---|
| 3 | 4 | 1 | 2 |
| 5 | 6 | 8 | – |
| 10 | 11 | 13 | 12 |
| H | $V_{bb}$ | L | H |
| L | $V_{bb}$ | H | L |
| $V_{bb}$ | H | H | L |
| $V_{bb}$ | L | L | H |

OR
NOR

PIN 7 = −5.2V ($V_{ee}$)
PIN 14 = GND ($V_{cc}$)

| MOTOROLA<br>MC 1204 L | AMPEX<br>586-489 | DUAL<br>4-INPUT GATE |
|---|---|---|

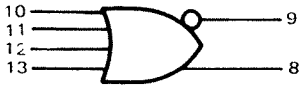



$5 = \overline{1 + 2 + 3 + 4}$

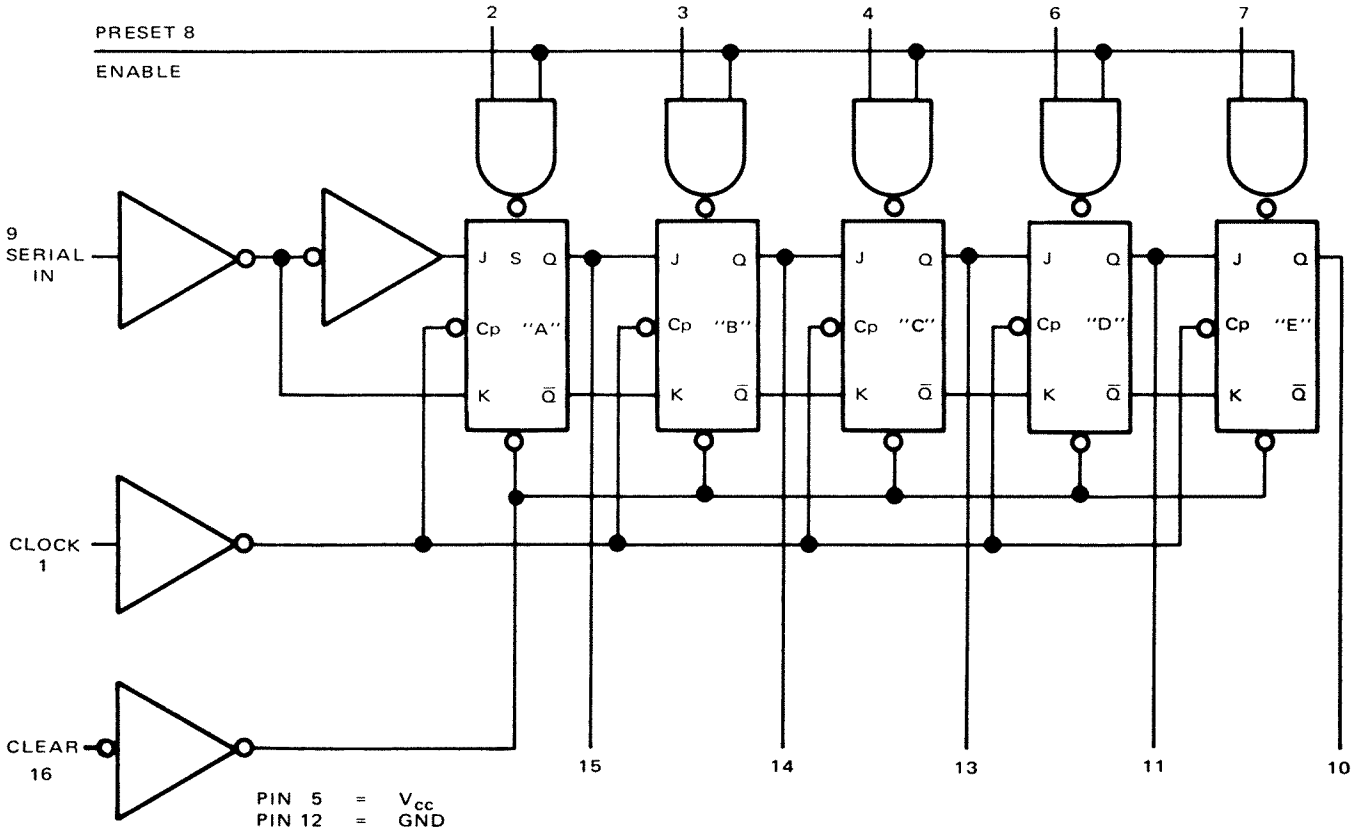
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| H | = | L | · | L | · | L | · | L |
| L | = | H | + | H | + | H | + | H |

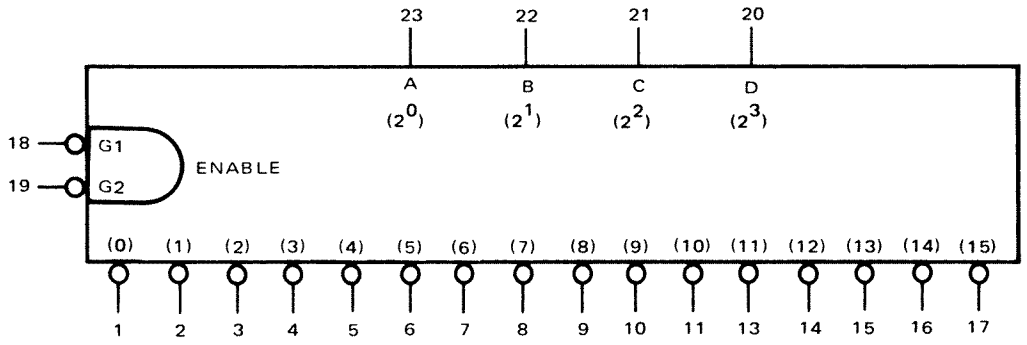
$6 = 1 + 2 + 3 + 4$

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| H | = | H | + | H | + | H | + | H |
| L | = | L | · | L | · | L | · | L |




PIN 7 = 5.2V ($V_{ee}$)
PIN 14 = GND ($V_{cc}$)


PRESET 8
ENABLE
2
3
4
6
7
9
SERIAL
IN
J S Q
Cp "A"
K Q̄
J Q
Cp "B"
K Q̄
J Q
Cp "C"
K Q̄
J Q
Cp "D"
K Q̄
J Q
Cp "E"
K Q̄
CLOCK
1
CLEAR
16
15
14
13
11
10
PIN 5 = Vcc
PIN 12 = GND



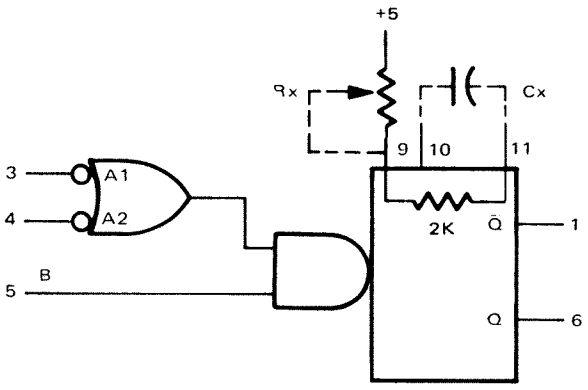

IF G1 OR G2 HIGH, ALL OUTPUTS HIGH.

G1 AND G2 LOW, BINARY NUMBER ON A, B, C, D INPUT DETERMINES WHICH OUTPUT LOW.

PIN 12 = GND

PIN 24 = $V_{cc}$

| D | C | B | A | OUTPUT "N" GOES LOW WITH G1/G2 LOW. |
|---|---|---|---|---|
| L | L | L | L | "0" |
| L | L | L | N | "1" |
| L | L | H | L | "2" |
| L | L | H | H | "3" |




Cx = 1000 μF MAX
Rx = 40K MAX

PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

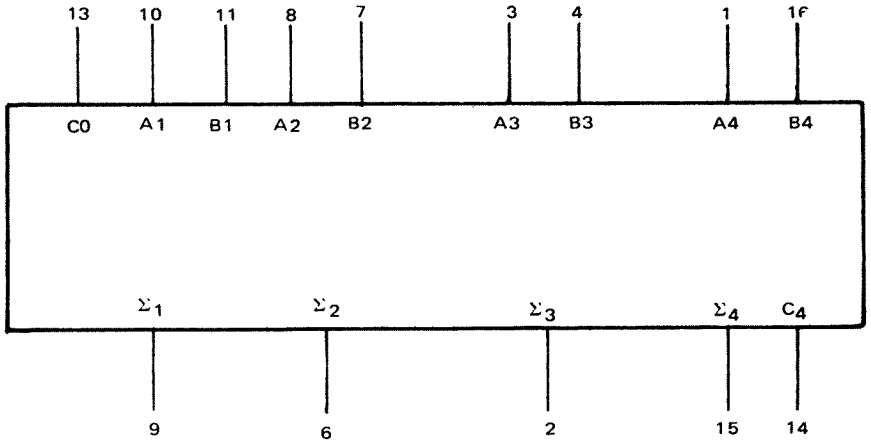
A1 AND A2 TRIGGER THE ONE-SHOT WHEN EITHER OR BOTH GO TO "0" WITH B AT "1."

B IS A POSITIVE SCHMITT – TRIGGER INPUT AND WILL TRIGGER THE ONE-SHOT WHEN IT GOES TO "1" WITH EITHER A1 OR A2 AT "0."

EXTERNAL TIMING CAPACITOR MAY BE CONNECTED FROM PINS 10 TO 11. WITH NO EXTERNAL TIMING COMPONENTS OUTPUT PULSE WIDTH IS APPROXIMATELY 30 NS.

TO USE INTERNAL TIMING RESISTOR, CONNECT PIN 9 TO 14 ($V_{cc}$). TO USE EXTERNAL VARIABLE TIMING RESISTOR, CONNECT BETWEEN PINS 9 AND 14. FOR ACCURATE NON-VARIABLE PULSE WIDTHS, CONNECT EXTERNAL TIMING RESISTOR FROM PIN 11 TO 14 WITH PIN 9 OPEN – CIRCUITED.

| TEXAS INSTRUMENTS<br>SN 7483 | AMPEX<br>586-554 | 4 BIT<br>BINARY FULL ADDER |
|---|---|---|




$A_1 + B_1 + C_0 = \Sigma_1$ AND $C_1$ (INTERNAL)

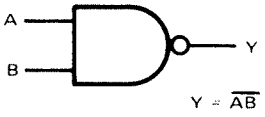
$A_2 + B_2 + C_1 = \Sigma_2$ AND $C_2$ (INTERNAL)

$A_3 + B_3 + C_2 = \Sigma_3$ AND $C_3$ (INTERNAL)

$A_4 + B_4 + C_3 = \Sigma_4$ AND $C_4$

PIN 5 = $V_{cc}$
PIN 12 = GND

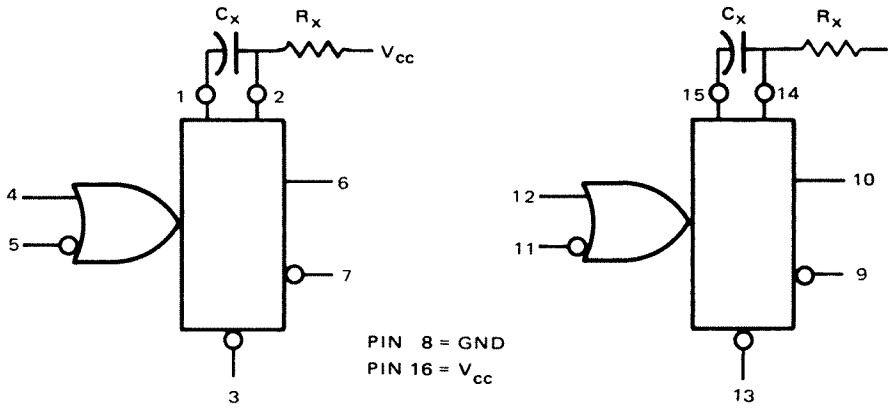
| TEXAS INSTRUMENTS<br>SN 7403 N | AMPEX<br>586-581 | QUAD 2-INPUT<br>NAND GATE |
|---|---|---|



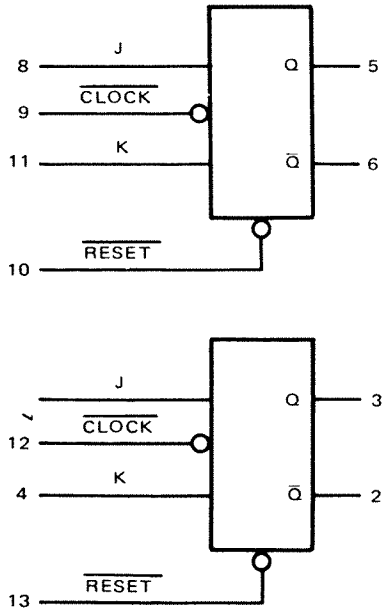

$Y = \overline{AB}$

PIN 7 = GND
PIN 14 = $V_{cc}$
OPEN COLLECTOR

| A | B | Y |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 9 | 10 | 8 |
| 12 | 13 | 11 |




$T = 0.31\ R_x\ C_x\ (1 + 1/R_x)$



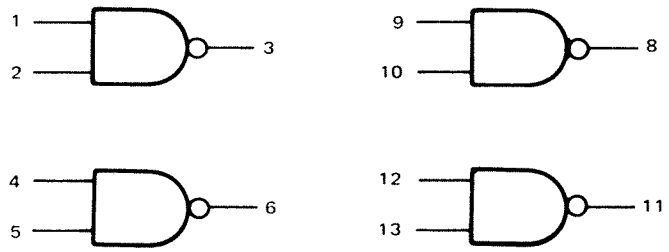

| tn | | tn+1 |
|---|---|---|
| J | K | Q |
| 0 | 0 | Qn |
| 0 | 1 | 0 |
| 1 | 0 | 1 |
| 1 | 1 | $\overline{Q}$n |

PIN 7 = GND
PIN 14 = $V_{cc}$ (5V)

DATA MUST BE APPLIED TO J-K INPUTS WHILE CLOCK IS LOW AND CHANGED ONLY WHEN CLOCK IS HIGH. WHEN CLOCK INPUT GOES HIGH, DATA IS TRANSFERRED TO MASTER SECTION AND STORED UNTIL CLOCK GOES LOW WHEN DATA IS TRANSFERRED TO SLAVE SECTION.

RESET INPUT OVERRIDES CLOCK. A LOGIC "0" AT RESET INPUT FORCES $\overline{Q}$ OUTPUT TO "1."

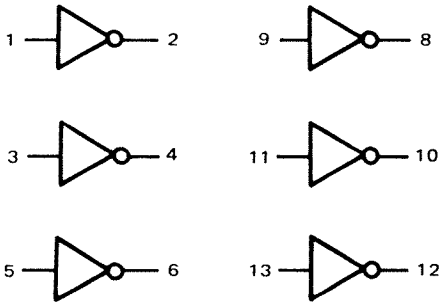
| TEXAS INSTRUMENTS<br>SN 74H01 | AMPEX<br>586-685 | QUAD 2-INPUT NAND<br>GATE (OPEN COLLECTOR) |
|---|---|---|




$3 = \overline{1 \cdot 2}$

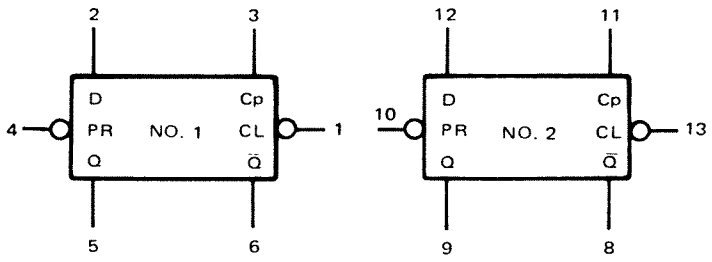
PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

| TEXAS INSTRUMENTS<br>SN 74H04N | AMPEX<br>586-688 | HEX<br>INVERTER |
|---|---|---|




PIN 7 = GND
PIN 14 = +5V ($V_{cc}$)

| TEXAS INSTRUMENTS<br>SN 74H74N | AMPEX<br>586-700 | DUAL D-TYPE EDGE-<br>TRIGGERED FLIP-FLOP |
|---|---|---|




PR = PRESET
CL = CLEAR
Cp = CLOCK

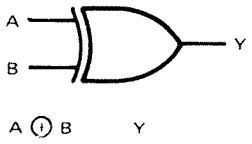
PIN 7 = GND
PIN 14 = $V_{cc}$

| $t_n$ D | $t_n + 1$ Q |
|---|---|
| L | L |
| H | H |

| PR | CL | Q |
|---|---|---|
| L | H | H |
| H | L | L |
| L | L | ND |

$t_n$ +1 IS TIME AFTER POSITIVE TRANSITION OF CLOCK

| TEXAS INSTRUMENTS<br>SN 7486 | AMPEX<br>586-705 | QUAD<br>EXCLUSIVE OR GATE |
|---|---|---|

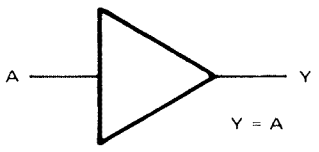



A ⊕ B = Y

| A | B | Y |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 9 | 10 | 8 |
| 12 | 13 | 11 |

PIN 7 = GND
PIN 14 = $V_{cc}$

| FAIRCHILD<br>FC 7407 PC | AMPEX<br>586-713 | HEX BUFFER/DRIVER<br>WITH OPEN-COLLECTOR<br>HIGH-VOLTAGE OUTPUT |
|---|---|---|



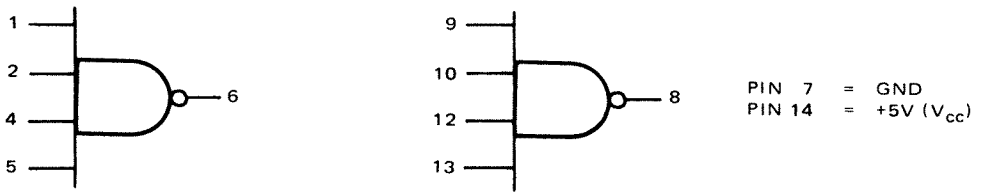

Y = A

HEX BUFFER

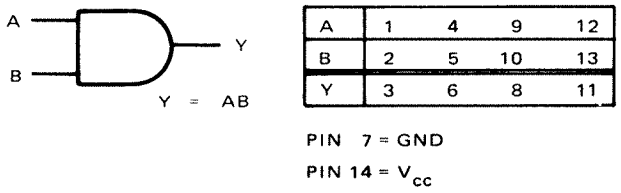
PIN 7 = GND
PIN 14 = $V_{cc}$

| A | Y |
|---|---|
| 1 | 2 |
| 3 | 4 |
| 5 | 6 |
| 9 | 8 |
| 11 | 10 |
| 13 | 12 |

| TEXAS INSTRUMENTS<br>SN 74H20N | AMPEX<br>586-738 | DUAL 4-INPUT<br>NAND GATE |
|---|---|---|

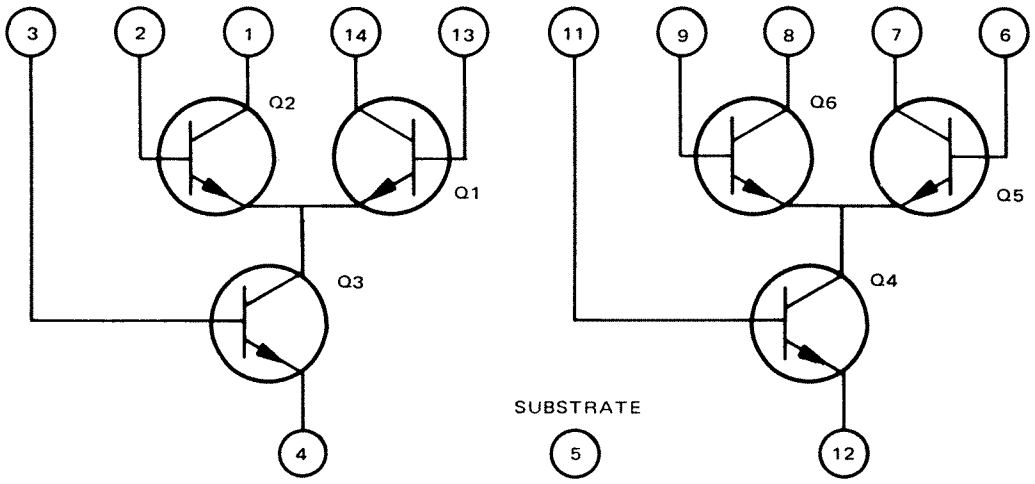


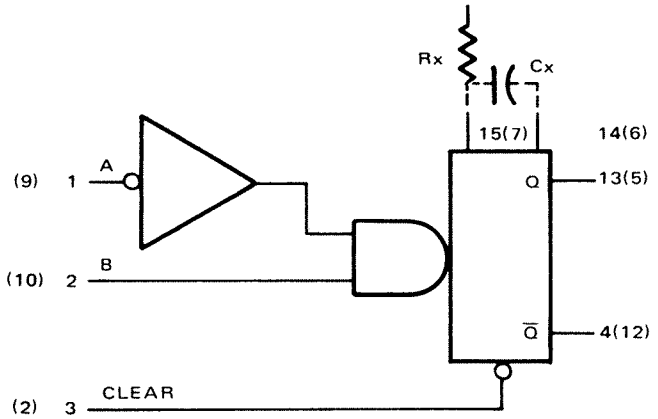

| TEXAS INSTRUMENTS<br>SN 7408 N | AMPEX<br>586-759 | QUAD 2-INPUT<br>AND GATE |
|---|---|---|




| | | | | |
|---|---|---|---|---|
| A | 1 | 4 | 9 | 12 |
| B | 2 | 5 | 10 | 13 |
| Y | 3 | 6 | 8 | 11 |

| RCA<br>CA 3054 | AMPEX<br>586-778 | TRANSISTOR<br>ARRAY |
|---|---|---|





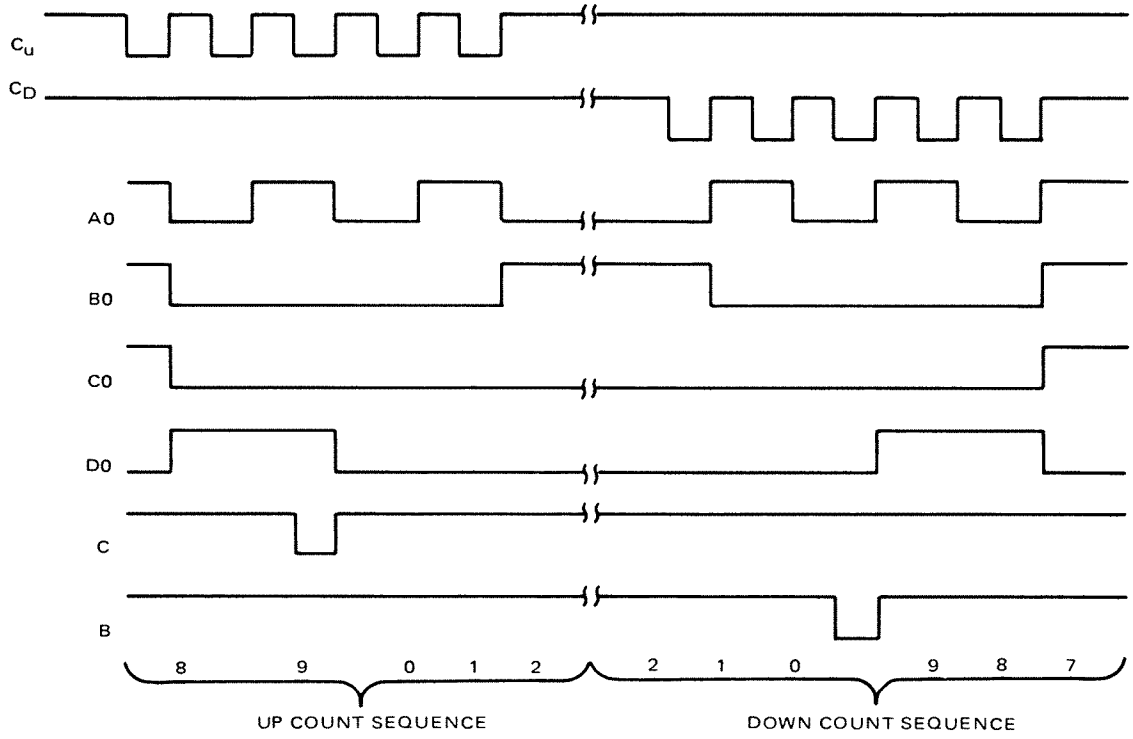

PIN 8 = GND
PIN 16 = +5V ($V_{cc}$)

Rx = 50K MAX

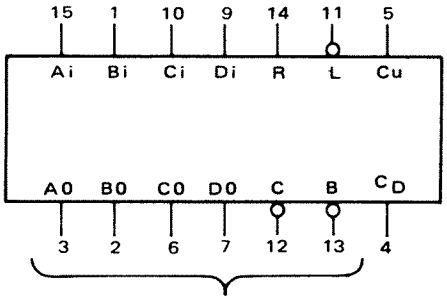
Cx = NO RESTRICTION

PIN NUMBERS IN PARENTHESIS ARE FOR SECTION 2

$$PW(ns) = 0.32\ Rx\ Cx\ (1 + \frac{0.7}{Rx})$$ WITH Rx IN KΩ AND Cx IN pF.




PIN 8 = GND
PIN 16 = +5V



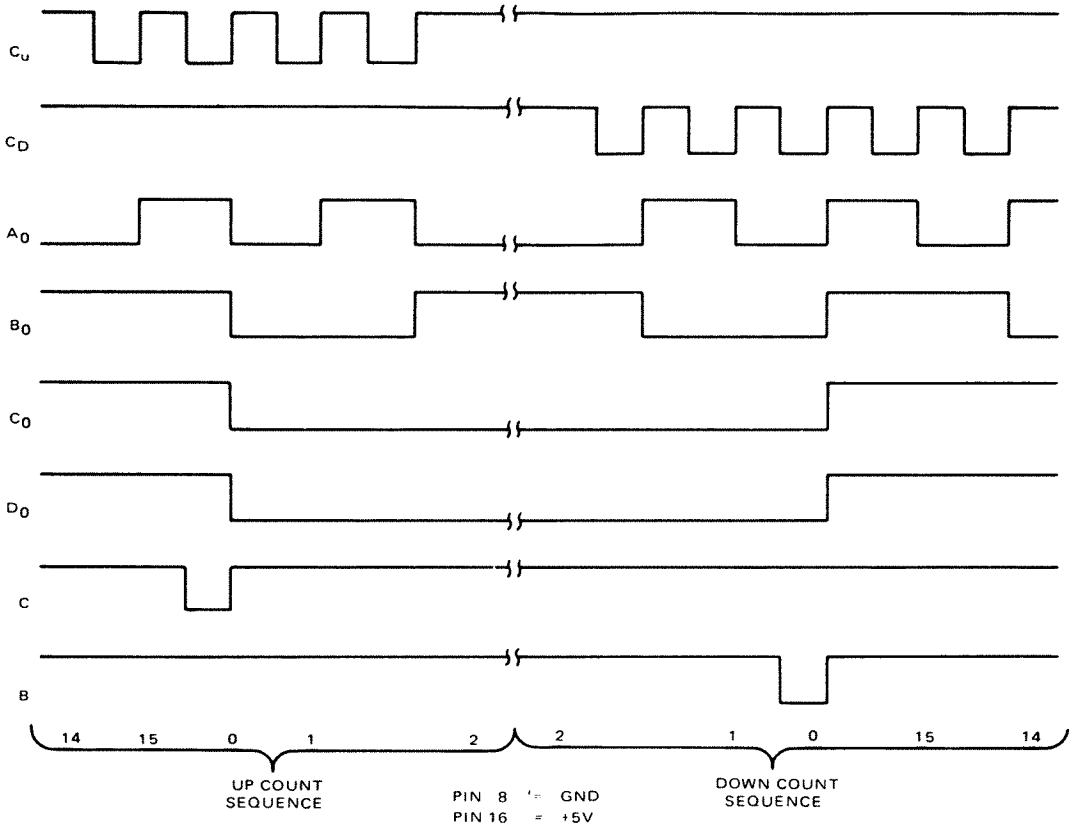

| $C_D$ | $C_U$ | R | L | Ai | Bi | Ci | Di | A0 | B0 | C0 | D0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| X | X | H | X | X | X | X | X | L | L | L | L |
| X | X | L | L | L | L | L | L | L | L | L | L |
| X | X | L | L | H | L | L | L | H | L | L | L |
| X | X | L | L | L | H | L | L | L | H | L | L |
| X | X | L | L | H | H | L | L | H | H | L | L |
| X | X | L | L | L | L | H | L | L | L | H | L |
| X | X | L | L | H | L | H | L | H | L | H | L |
| X | X | L | L | L | H | H | L | L | H | H | L |
| X | X | L | L | H | H | H | L | H | H | H | L |
| X | X | L | L | L | L | L | H | L | L | L | H |
| X | H | L | H | H | L | L | H | H | L | L | H |
| X | L | L | H | H | L | L | H | H | L | L | H |
| H | X | L | H | L | L | L | L | L | L | L | L |
| L | X | L | H | L | L | L | L | L | L | L | L |

LOW = ACTIVE OUT

| C | B |
|---|---|
| H | H |
| L | H |
| H | H |
| H | L |

ASYNCHRONOUS LOADING

Ai, Bi,
Ci, Di = DATA IN
A0, B0,
C0, D0 = DATA OUT
C = CARRY OUT
B = BORROW OUT
R = CLEAR (RESET)
L = LOAD DATA IN
$C_u$ = COUNT UP CLOCK
$C_D$ = COUNT DOWN CLOCK

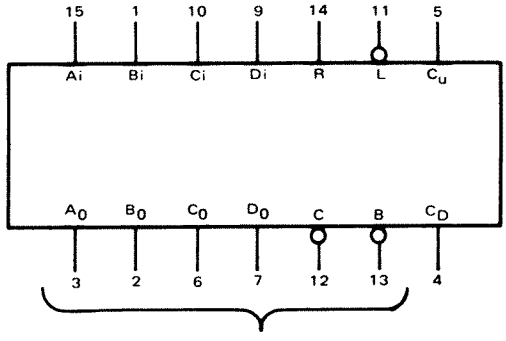



| $C_D$ | $C_U$ | R | L | Ai | Bi | Ci | Di | $A_0$ | $B_0$ | $C_0$ | $D_0$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| X | X | H | X | X | X | X | X | L | L | L | L |
| X | X | L | L | L | L | L | L | L | L | L | L |
| X | X | L | L | H | L | L | L | H | L | L | L |
| X | X | L | L | L | H | L | L | L | H | L | L |
| X | X | L | L | H | H | L | L | H | H | L | L |
| X | X | L | L | L | L | H | L | L | L | H | L |
| X | X | L | L | H | L | H | L | H | L | H | L |
| X | X | L | L | L | H | H | L | L | H | H | L |
| X | X | L | L | H | H | H | L | H | H | H | L |
| X | X | L | L | L | L | L | H | L | L | L | H |
| X | X | L | L | H | L | L | H | H | L | L | H |
| X | X | L | L | L | H | L | H | L | H | L | H |
| X | X | L | L | H | H | L | H | H | H | L | H |
| X | X | L | L | L | L | H | H | L | L | H | H |
| X | X | L | L | H | L | H | H | H | L | H | H |
| X | X | L | L | L | H | H | H | L | H | H | H |
| X | X | L | L | H | H | H | H | H | H | H | H |
| X | H | L | H | H | H | H | H | H | H | H | H |
| X | L | L | H | H | H | H | H | H | H | H | H |
| H | X | L | H | L | L | L | L | L | L | L | L |
| L | X | L | H | L | L | L | L | L | L | L | L |

ASYNCHRONOUS LOADING

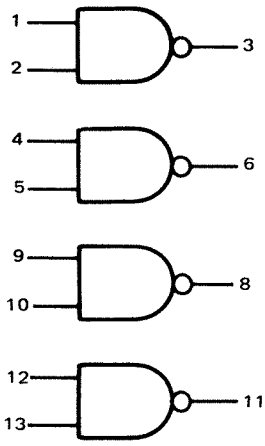
LOW = ACTIVE OUTPUT

| C | B |
|---|---|
| H | H |
| L | H |
| H | H |
| H | L |

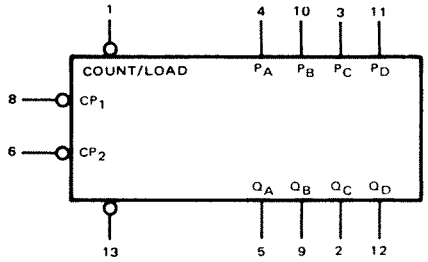



ALL OTHERS ARE INPUTS

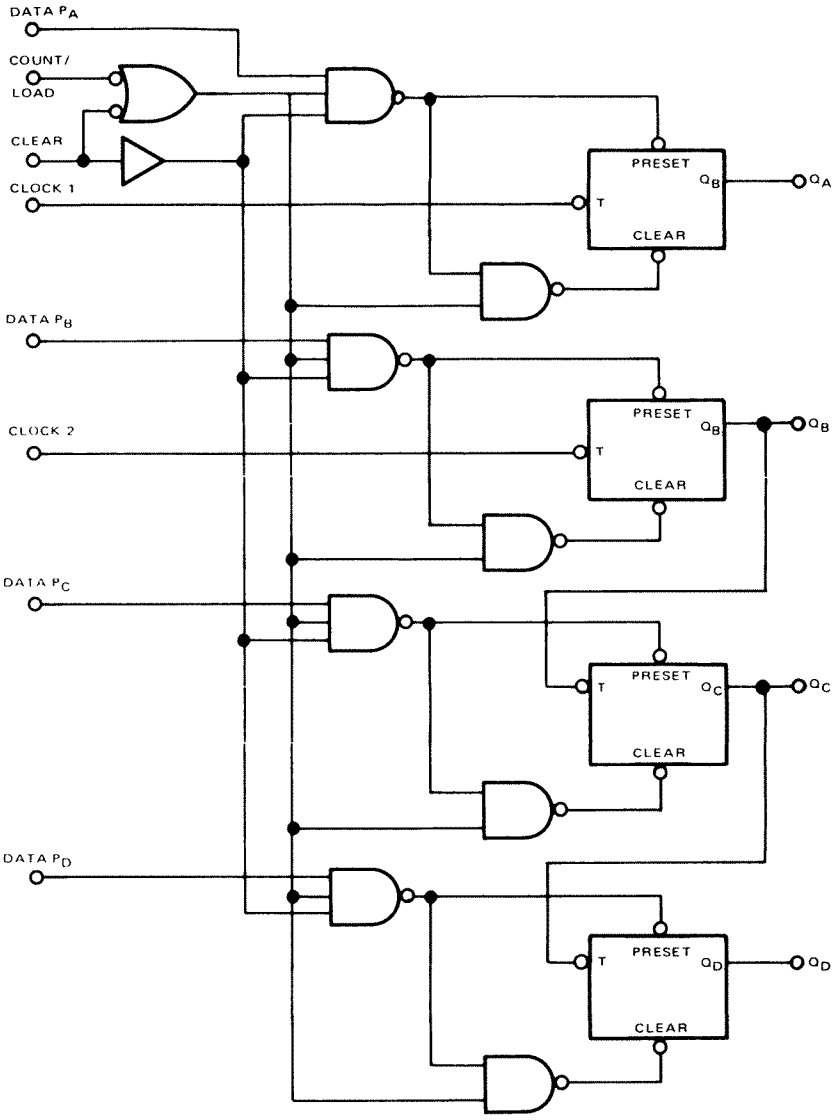
Ai Bi Ci Di = DATA IN
$A_0$ $B_0$ $C_0$ $D_0$ = DATA OUT
C = CARRY OUT
B = BORROW OUT
R = CLEAR (RESET)
L = LOAD DATA IN (PRESET)
$C_u$ = COUNT UP CLOCK
$C_D$ = COUNT DOWN CLOCK




PIN 7 = GND
PIN 14 = +5V ($V_{CC}$)




PIN 7 = GND
PIN 14 = +5V ($V_{CC}$)




TRUTH TABLE
(SEE NOTE A)

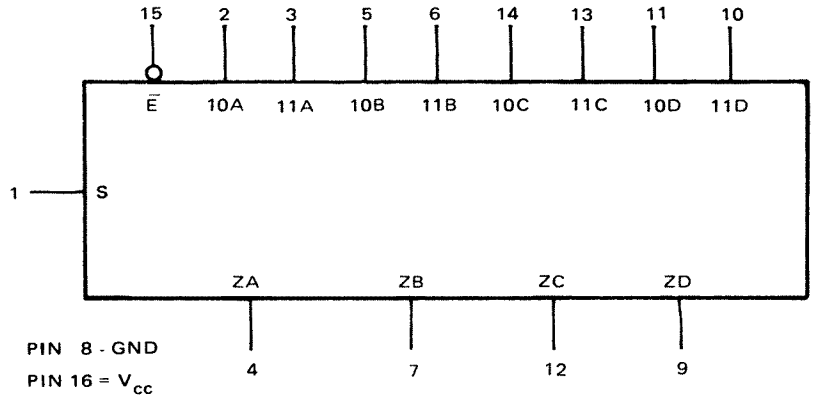
| COUNT | OUTPUT | | | |
|---|---|---|---|---|
| | $Q_D$ | $Q_C$ | $Q_B$ | $Q_A$ |
| 0 | L | L | L | L |
| 1 | L | L | L | H |
| 2 | L | L | H | L |
| 3 | L | L | H | H |
| 4 | L | H | L | L |
| 5 | L | H | L | H |
| 6 | L | H | H | L |
| 7 | L | H | H | H |
| 8 | H | L | L | L |
| 9 | H | L | L | H |
| 10 | H | L | H | L |
| 11 | H | L | H | H |
| 12 | H | H | L | L |
| 13 | H | H | L | H |
| 14 | H | H | H | L |
| 15 | H | H | H | H |

NOTE:
A. OUTPUT $Q_A$ CONNECTED TO CLOCK 2 INPUT.

THE OUTPUT OF FLIP-FLOP A IS NOT INTERNALLY CONNECTED TO THE SUCCEEDING FLIP-FLOPS, THEREFORE THE COUNTER MAY BE OPERATED IN TWO INDEPENDENT MODES:

1. WHEN USED AS A HIGH SPEED 4-BIT RIPPLE COUNTER, OUTPUT $Q_A$ MUST BE EXTERNALLY CONNECTED TO THE CLOCK 2 INPUT. THE INPUT COUNT PULSES ARE APPLIED TO THE CLOCK 1 INPUT. SIMULTANEOUS DIVISIONS BY 2, 4, 8 AND 16 ARE PERFORMED AT THE $Q_B$, $Q_C$, AND $Q_D$ OUTPUT AS SHOWN IN THE TRUTH TABLE AT THE RIGHT.
2. WHEN USED AS A 3-BIT COUNTER, THE INPUT COUNT PULSES ARE APPLIED TO THE CLOCK 2 INPUT. SIMULTANEOUS FREQUENCY DIVISIONS BY 2, 4, AND 8 ARE AVAILABLE AT $Q_B$, $Q_C$, AND $Q_D$ OUTPUTS. INDEPENDENT USE OF FLIP-FLOP A IS AVAILABLE IF THE LOAD AND CLEAR FUNCTIONS COINCIDE WITH THOSE OF THE 3-BIT RIPPLED COUNTER.

| FAIRCHILD<br>FC 74157 PC | AMPEX<br>586-903 | QUAD 2-INPUT<br>MULTIPLEXER |
|---|---|---|




TRUTH TABLE

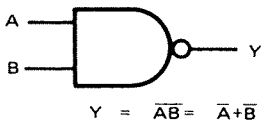
| ENABLE | SELECT INPUT | INPUTS | | OUTPUT |
|---|---|---|---|---|
| $\bar{E}$ | S | $I_{0X}$ | $I_{1X}$ | $Z_X$ |
| H | X | X | X | L |
| L | H | X | L | L |
| L | H | X | H | H |
| L | L | L | X | L |
| L | L | H | X | H |

H = HIGH VOLTAGE LEVEL
L = LOW VOLTAGE LEVEL
X = EITHER HIGH OR LOW LOGIC LEVEL

OUTPUT LOGIC EQUATIONS ARE:

$Z_a = E \bullet (I_{1a} \bullet S + I_{0a} \bullet \bar{S})$ $Z_b = E \bullet (I_{1b} \bullet S + I_{0b} \bullet \bar{S})$
$Z_c = E \bullet (I_{1c} \bullet S + I_{0c} \bullet \bar{S})$ $Z_d = E \bullet (I_{1d} \bullet S + I_{0d} \bullet \bar{S})$

| TEXAS INSTRUMENTS<br>SN 7437 N | AMPEX<br>586-910 | 2-INPUT<br>NAND BUFFER |
|---|---|---|




$Y = \overline{AB} = \bar{A} + \bar{B}$

| | | | | |
|---|---|---|---|---|
| A | 1 | 4 | 9 | 12 |
| B | 2 | 5 | 10 | 13 |
| Y | 3 | 6 | 8 | 11 |

PIN 7 = GND
PIN 14 = $V_{cc}$

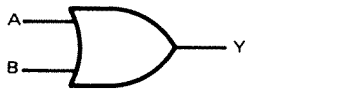
| TEXAS INSTRUMENTS<br>SN 7427 N | AMPEX<br>586-917 | 3-INPUT<br>NOR GATE |
|---|---|---|




$Y = \overline{A+B+C} = \overline{A}\,\overline{B}\,\overline{C}$

| | | | |
|---|---|---|---|
| A | 1 | 9 | 3 |
| B | 2 | 10 | 4 |
| C | 13 | 11 | 5 |
| Y | 12 | 8 | 6 |

| TEXAS INSTRUMENTS<br>SN 7432 | AMPEX<br>586-918 | OR<br>GATE |
|---|---|---|



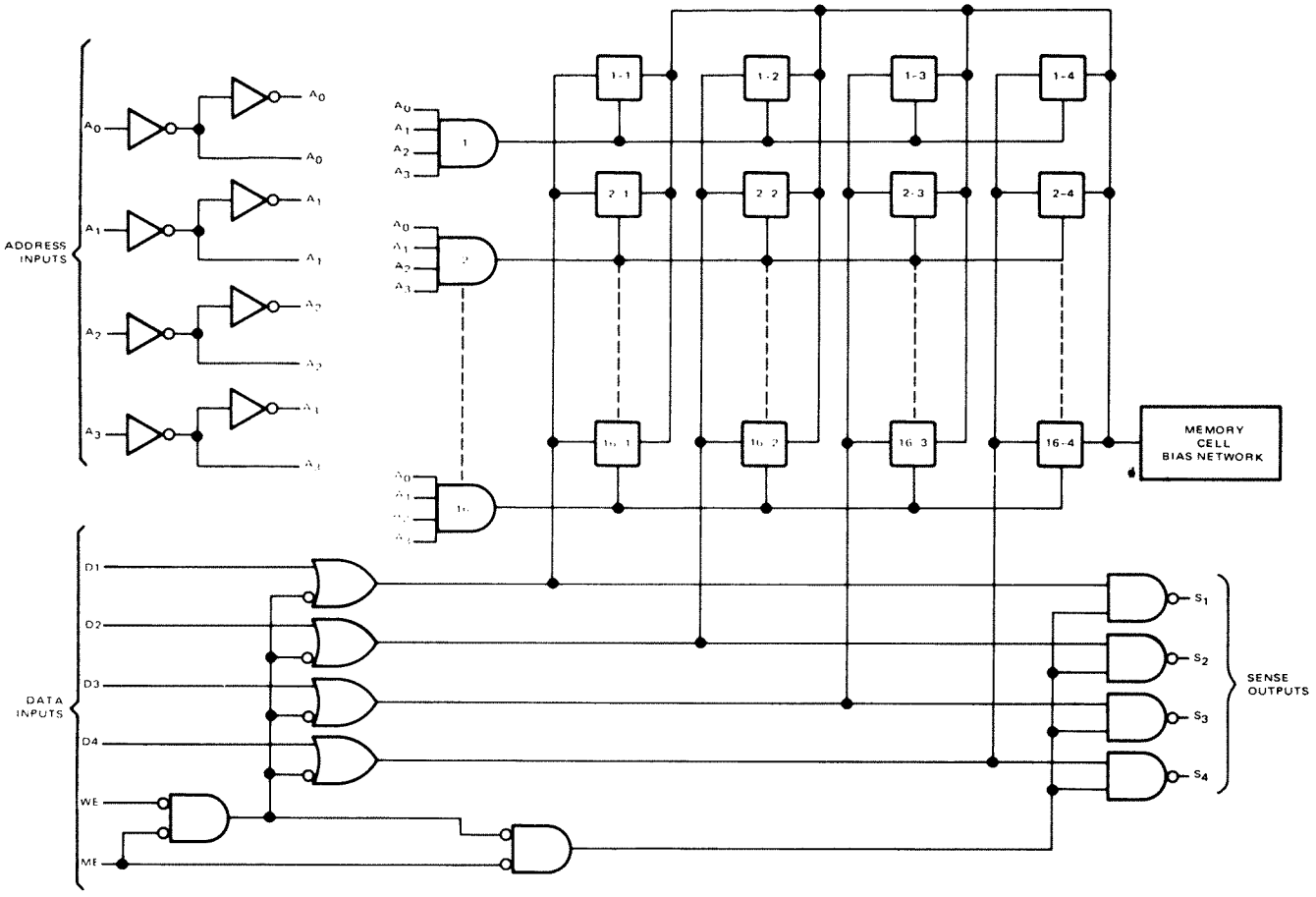

$Y = A + B$

PIN 7 = GND

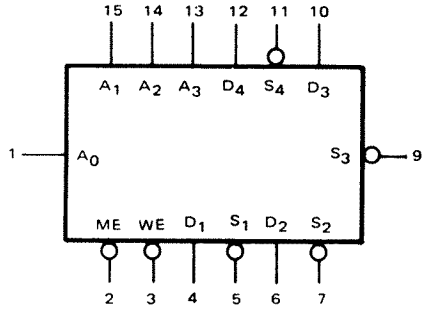
PIN 14 = $V_{cc}$

TOTEM OUTPUT

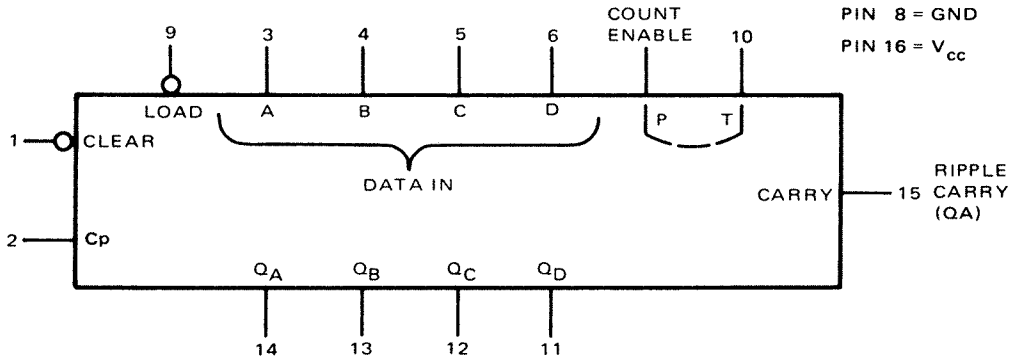
| A | B | Y |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 9 | 10 | 8 |
| 12 | 13 | 11 |



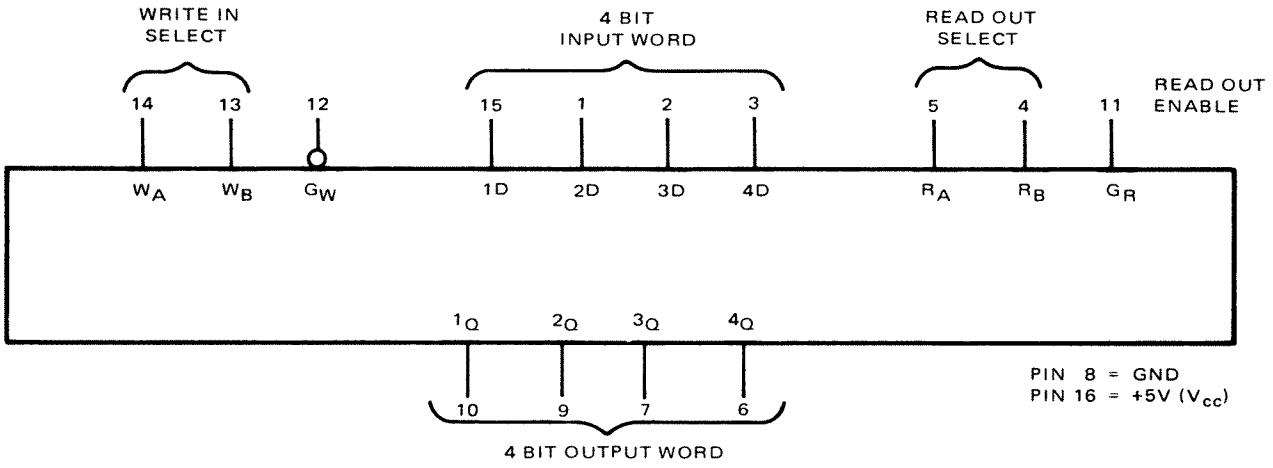

| TRUTH TABLE | | | |
|---|---|---|---|
| MEMORY ENABLE | WRITE ENABLE | OPERATION | OUTPUTS |
| 0 | 0 | WRITE | LOGICAL "1" STATE |
| 0 | 1 | READ | COMPLEMENT OF DATA STORED IN MEMORY |
| 1 | X | HOLD | LOGICAL "1" STATE |




PIN 8 = GND
PIN 16 = +5V ($V_{CC}$)




CLEAR AND LOAD SYNCHRONOUS WITH POSITIVE TRANSITION OF CLOCK PULSE.




**WORD**

| $W_B$ | $W_A$ | $G_W$ | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|
| X | X | H | Qn | Qn | Qn | Qn |
| L | L | L | D | Qn | Qn | Qn |
| L | H | L | Qn | D | Qn | Qn |
| H | L | L | Qn | Qn | D | Qn |
| H | H | L | Qn | Qn | Qn | D |

**OUTPUTS**

| $R_B$ | $R_A$ | $G_R$ | $1_Q$ | $2_Q$ | $3_Q$ | $4_Q$ |
|---|---|---|---|---|---|---|
| X | X | H | H | H | H | H |
| L | L | L | W0B1 | W0B2 | W0B3 | W0B4 |
| L | H | L | W1B1 | W1B2 | W1B3 | W1B4 |
| H | L | L | W2B1 | W2B2 | W2B3 | W2B4 |
| H | H | L | W3B1 | W3B2 | W3B3 | W3B4 |

1. THERE ARE 16 INTERNAL FLIP-FLOPS, FOUR PER "WORD".
2. WITH WRITE ENABLE $G_W$ (GATE WRITE) LOW, THE BINARY NUMBER REPRESENTED BY $W_BW_A$ SELECTS A GROUP OF 4, WHOSE INTERNAL Q OUTPUTS FOLLOW LEVELS OF THE $1_D$, $2_D$, $3_D$, $4_D$ INPUTS (D IN TABLE). THE OTHER 12 FLIP-FLOPS NOT SO SELECTED REMAIN IN THEIR PREVIOUS STATE. (Qn)
3. WITH READ ENABLE $G_R$ (GATE READ) HIGH ALL OUTPUTS ($1_Q$, $2_Q$, $3_Q$, $4_Q$) HIGH. WHEN $G_R$ LOW, THE BINARY NUMBER REPRESENTED BY $R_B$, $R_A$ SELECTS A GROUP OF 4 FLIP-FLOPS, AND THE 4 BIT OUTPUT WORD FOLLOWS THE Q OUTPUT OF SELECTED FLIP-FLOPS (W0B1, W0B2, W0B3, W0B4).

# 256-BIT BIPOLAR RANDOM ACCESS MEMORY (OPEN COLLECTOR OUTPUT)

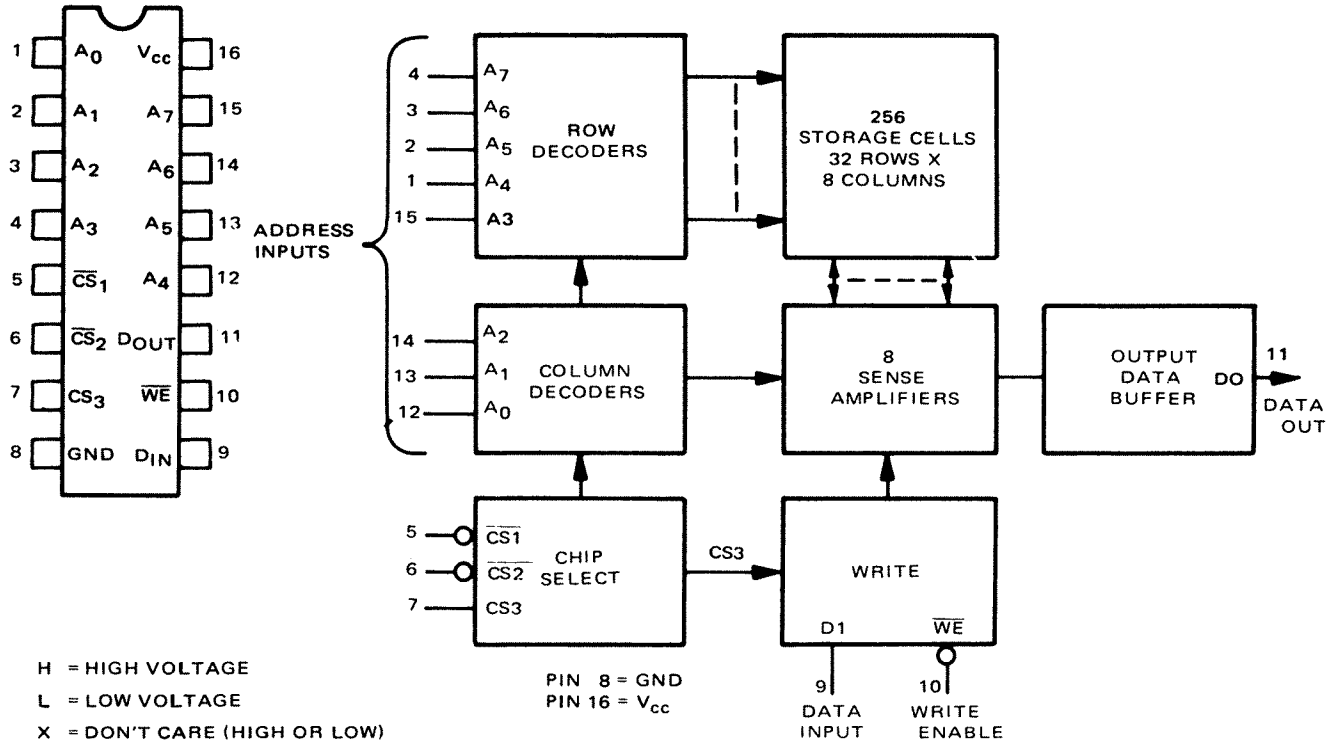



TABLE 1 – TRUTH TABLE

| INPUTS | | | | | OUTPUT | |
|---|---|---|---|---|---|---|
| CS | | | | | | |
| PIN 5 | PIN 6 | PIN 7 | $\overline{WE}$ | DI | DO | MODE |
| H | X | X | X | X | H | NOT SELECTED |
| X | H | X | X | X | H | NOT SELECTED |
| X | X | L | X | X | H | NOT SELECTED |
| L | L | H | L | L | H | WRITE "0" |
| L | L | H | L | H | H | WRITE "1" |
| L | L | H | H | X | DO | READ DATA FROM ADDRESSED LOCATION |

THE 93410 IS A FULLY DECODED 256-BIT RANDOM ACCESS MEMORY ORGANIZED 256 WORDS BY 1 BIT. BIT SELECTION IS ACHIEVED BY MEANS OF AN 8-BIT ADDRESS, $A_0$ THRU $A_7$.

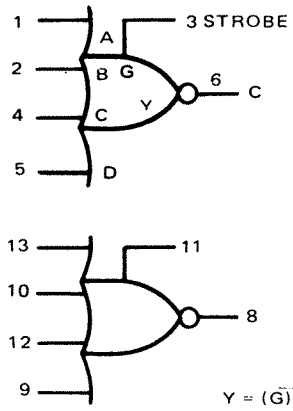
THREE CHIP SELECT INPUTS ARE PROVIDED, TWO ARE ACTIVE LOW ($\overline{CS_1}$ AND ($\overline{CS_2}$) AND THE THIRD ACTIVE HIGH ($CS_3$) FOR MAXIMUM LOGIC FLEXIBILITY. THIS PERMITS MEMORY ARRAY EXPANSION UP TO 2048 WORDS WITHOUT THE NEED FOR ADDITIONAL EXTERNAL DECODERS.

THE READ AND WRITE OPERATIONS ARE CONTROLLED BY THE STATE OF THE ACTIVE LOW WRITE ENABLE $\overline{WE}$ (PIN 10). WITH $\overline{WE}$ HELD LOW AND THE CHIP SELECTED, THE DATA AT $D_{IN}$ IS WRITTEN INTO THE ADDRESSED LOCATION. TO READ, $\overline{WE}$ IS HELD HIGH AND THE CHIP SELECTED. DATA IN THE SPECIFIED LOCATION IS PRESENTED AT $D_{OUT}$ AND IS NON-INVERTED.

TRUTH TABLE

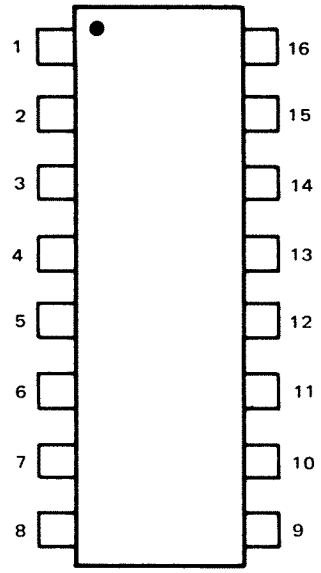
| IN | | | | | OUT |
|---|---|---|---|---|---|
| A | B | C | D | G | Y |
| H | X | X | X | H | L |
| X | H | X | X | H | L |
| X | X | X | X | H | L |
| X | X | H | X | H | L |
| X | X | X | H | H | L |
| L | L | L | L | X | H |
| X | X | X | X | L | H |

X = DON'T CARE




PIN 7 = GND
PIN 14 = $V_{cc}$

$Y = (\overline{G})(\overline{A+B+C+D}) = \overline{G} + \overline{A}\,\overline{B}\,\overline{C}\,\overline{D}$




| | | | |
|---|---|---|---|
| 1. | OUT 1 | 16. | IN 4 |
| 2. | NC | 15. | NC |
| 3. | IN 1 | 14. | OUT 4 |
| 4. | Ø1 | 13. | NC |
| 5. | $V_{cc}$ | 12. | $V_{dd}$ |
| 6. | OUT 2 | 11. | Ø2 |
| 7. | NC | 10. | IN 3 |
| 8. | IN 2 | 9. | OUT 3 |

PIN 5 = +5V ( $V_{cc}$)
PIN 12 = -5V ( $V_{dd}$)

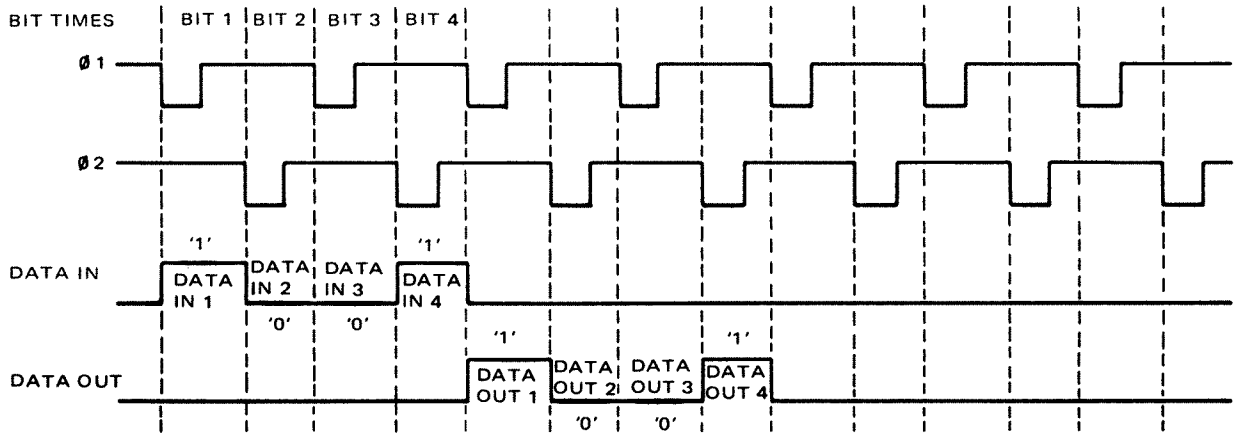
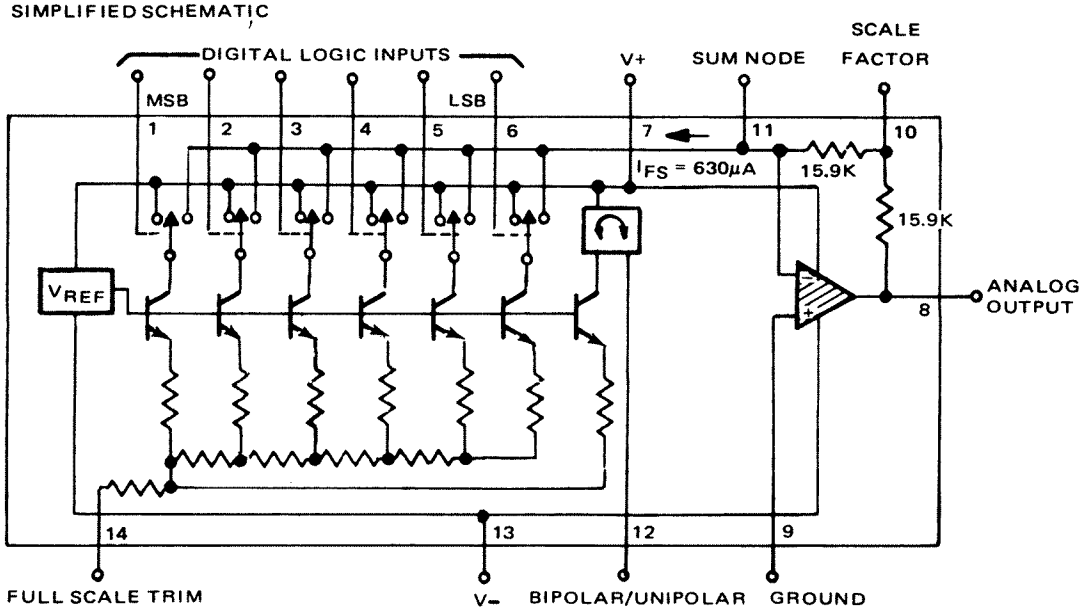
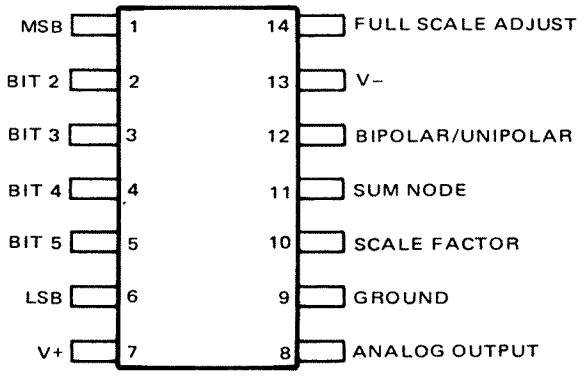


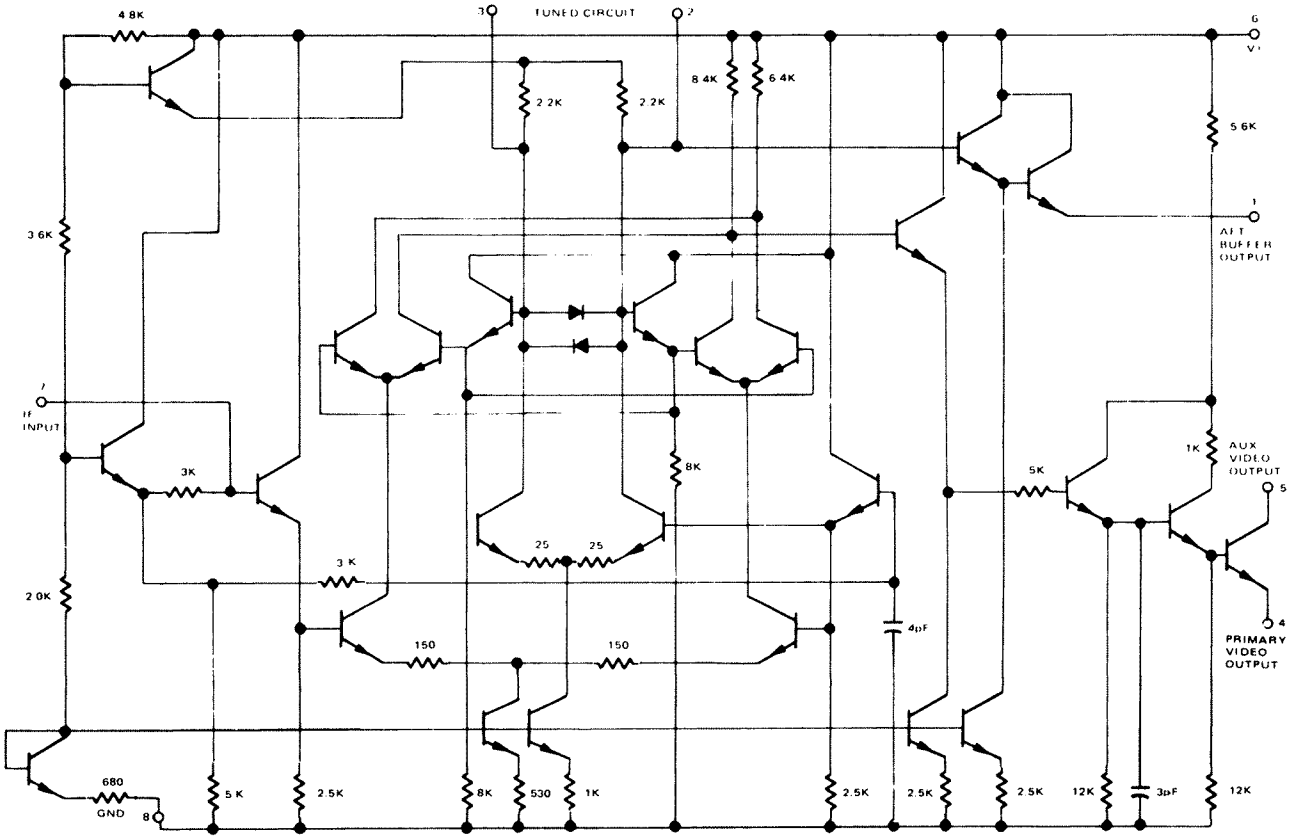

FIGURE 1

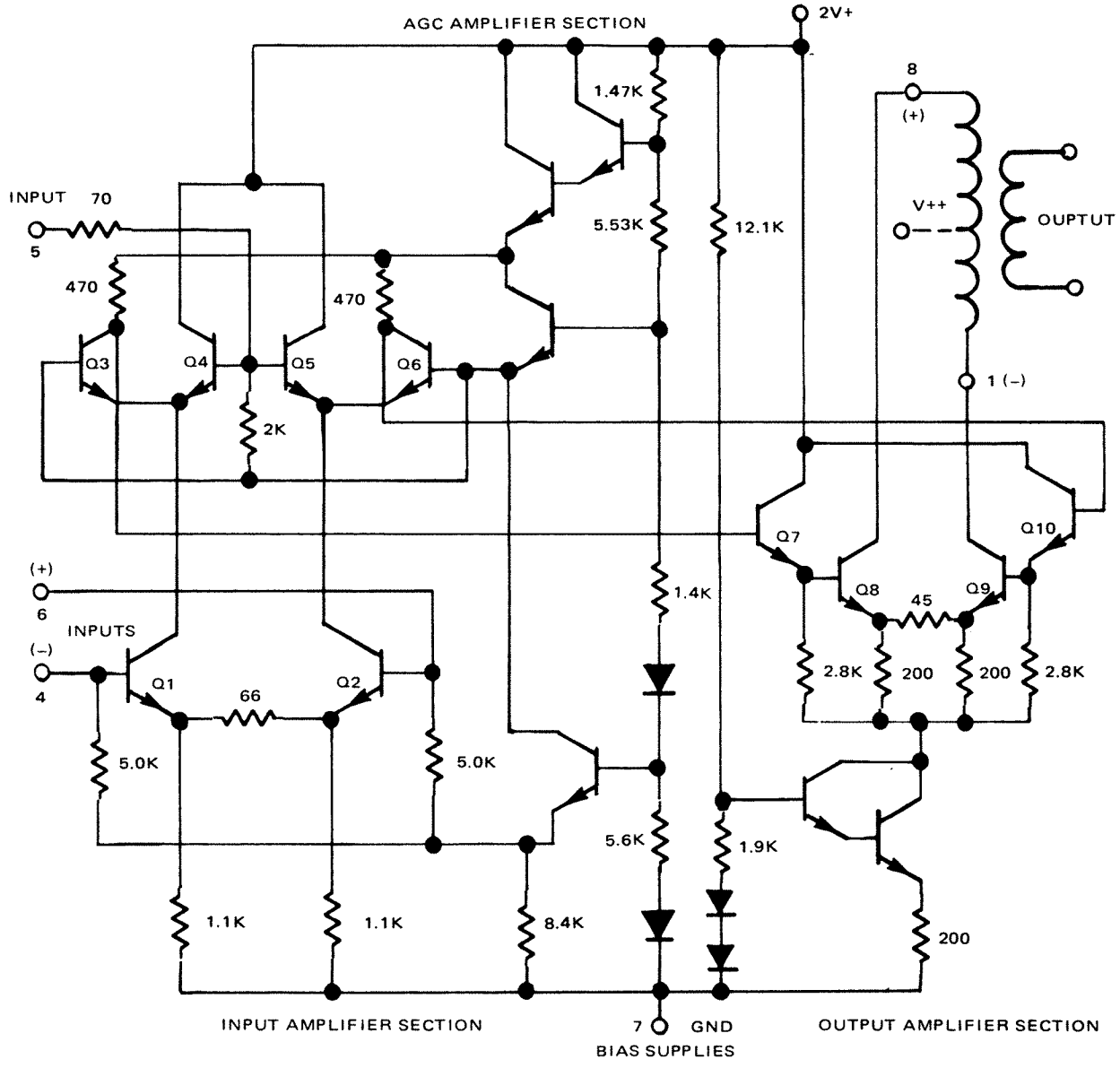
FIGURE 1 IS A SIMPLIFIED ILLUSTRATION OF THE TIMING OF A 4-BIT MULTIPLEXED REGISTER SHOWING INPUT OUTPUT RELATIONSHIPS WITH RESPECT TO THE CLOCK. IF DATA ENTERS THE REGISTER AT Ø1 TIME, IT EXITS AT Ø1 TIME, (BEGINNING ON Ø1'S NEGATIVE-GOING EDGE AND ENDING ON THE SUCCEEDING Ø2'S NEGATIVE-GOING EDGE).

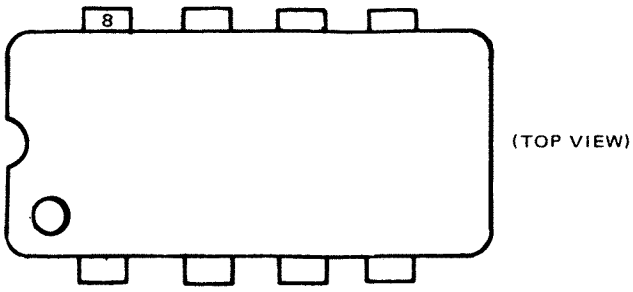
SIMPLIFIED SCHEMATIC



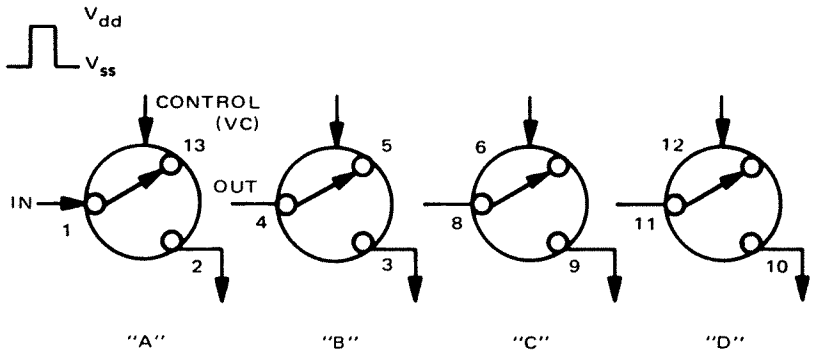




4.8K
3
TUNED CIRCUIT
2
6
2.2K
2.2K
8.4K
6.4K
5.6K
3.6K
1
AFT
BUFFER
OUTPUT
7
IF
INPUT
3K
8K
1K
AUX
VIDEO
OUTPUT
5K
5
25
25
3 K
2.0K
4pF
150
150
4
PRIMARY
VIDEO
OUTPUT
680
GND
8
5 K
2.5K
8K
530
1K
2.5K
2.5K
2.5K
12K
3pF
12K


AGC AMPLIFIER SECTION
2V+
1.47K
8
(+)
INPUT 70
5
5.53K
12.1K
V++
OUPTUT
470
470
Q3
Q4
Q5
Q6
2K
1 (-)
Q7
Q10
(+)
6
INPUTS
(-)
4
1.4K
Q8
45
Q9
2.8K
200
200
2.8K
Q1
66
Q2
5.0K
5.0K
5.6K
1.9K
1.1K
1.1K
8.4K
200
INPUT AMPLIFIER SECTION
7
GND
BIAS SUPPLIES
OUTPUT AMPLIFIER SECTION

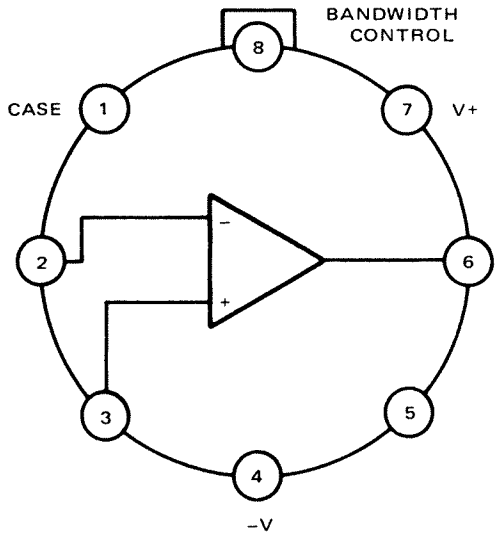

8
(TOP VIEW)

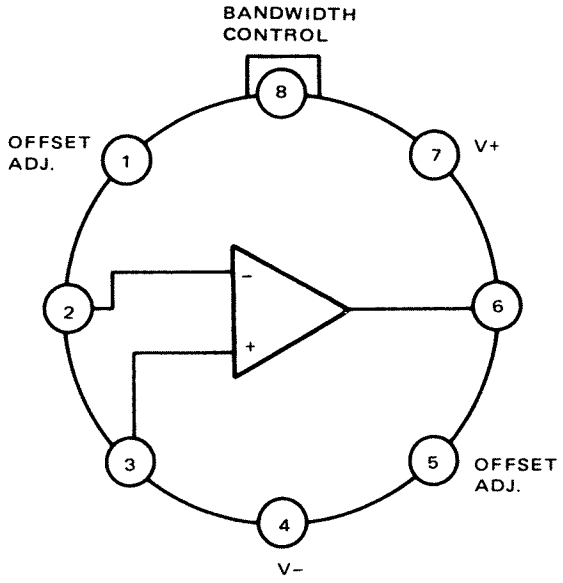
| RCA<br>CD 4016-AE | AMPEX<br>587-168 | COS/MOS QUAD<br>BILATERAL SWITCH |
|---|---|---|

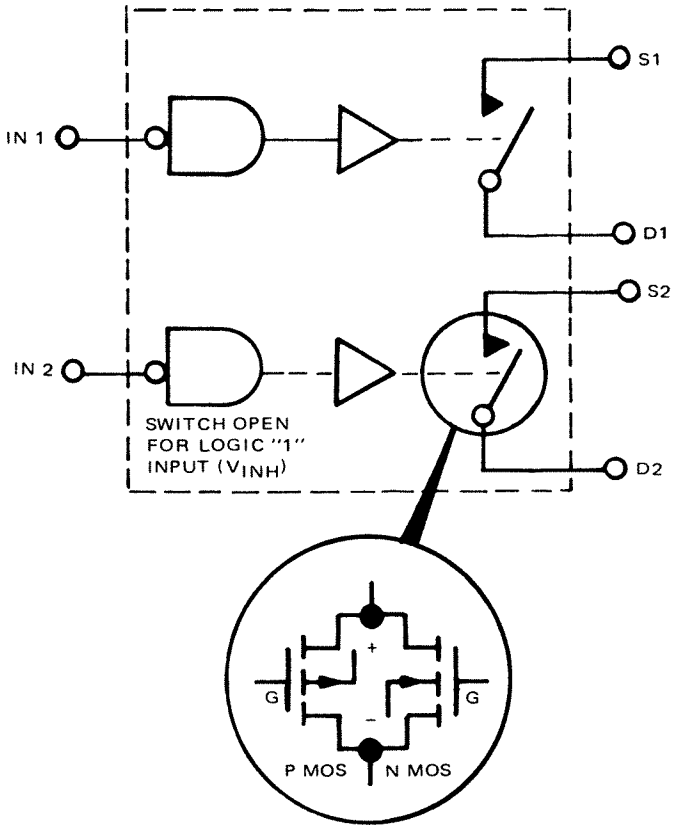


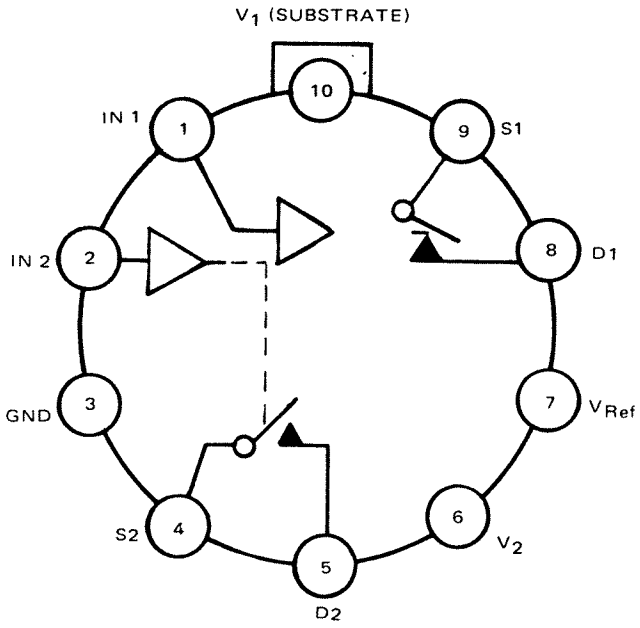

PIN 7 = $V_{ss}$ (NEGATIVE)
PIN 14 = $V_{dd}$ (POSITIVE)

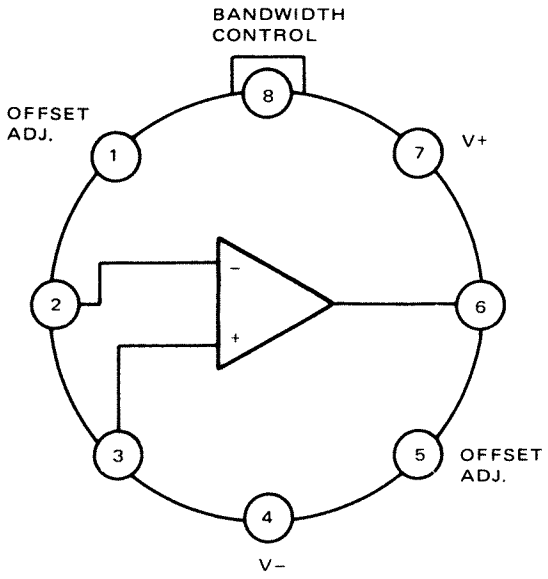
| HARRIS<br>HA 2-911-5 | AMPEX<br>587-169 | OPERATIONAL<br>AMPLIFIER |
|---|---|---|




BANDWIDTH
CONTROL
8
OFFSET
ADJ.
1
7
V+
2
6
3
5
OFFSET
ADJ.
4
V-


IN 1
IN 2
S1
D1
S2
D2
SWITCH OPEN
FOR LOGIC "1"
INPUT ($V_{INH}$)
G
G
+
-
P MOS
N MOS


$V_1$ (SUBSTRATE)
10
IN 1
1
9
S1
IN 2
2
8
D1
GND
3
7
$V_{Ref}$
S2
4
6
$V_2$
5
D2


BANDWIDTH
CONTROL
8
OFFSET
ADJ.
1
7
V+
2
6
3
5
OFFSET
ADJ.
4
V–